

## **PART 1 GENERAL**

### **1.1 Site Work**

- .1 After project completion return the outside site conditions back to original conditions. Photos of the Site will be taken before Work begins on Site to assist in confirming that after all Work is completed, the Site is returned to its original condition in accordance with City of Winnipeg Standard Specifications.

### **1.2 Use of Site and Facilities**

- .1 Contractor may at his discretion place a construction trailer on the Site and store materials in designated areas.
- .2 Potable water is not available on the Site. Make arrangements to provide drinking water for workers as required.
- .3 Contractor to provide portable washroom facilities outside the pumping station.

### **1.3 Regulations**

- .1 All Work shall be in full accordance with all applicable Codes, Regulations, By-laws, and ordinances.

### **1.4 Permits, Fees and Inspections**

- .1 Apply for all permits, supply all test certificates and pay all fees to authorities having jurisdiction regarding the installation and inspection of the systems installed under this Contract.

### **1.5 Existing Conditions and Other Trades**

- .1 Visit the Site to determine existing conditions affecting the Work of this Division.
- .2 Examine all drawings and become fully familiar with the Work of other trades in all divisions under this Contract.
- .3 Cooperate with all other trades. Pay particular attention to the proximity of the Work to all electrical cables, control conduits, and utilities. Maintain maximum clear ceiling heights throughout.

### **1.6 Metric Conversion**

- .1 All units in this division are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.
- .3 On all submittals (Shop Drawings, etc.) use the same SI units as stated in the Specifications.

### **1.7 Cutting and Patching**

- .1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Contract Administrator before cutting or burning structural members.
- .4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials.

### **1.8 Equipment Protection and Clean-up**

- .1 Protect equipment and materials in storage on-site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping systems.
- .2 Protect equipment with crates and polyethylene covers.

### **1.9 Temporary Usage**

- .1 Usage by the City of any process device, apparatus, machinery, or equipment prior to Total Performance being issued is not to be construed as acceptance.

### **1.10 Temporary Bypass Pumping**

- .1 To protect the station's pumping capacity in case of a power outage, a standby system of pumping that does not depend on electric power from Manitoba Hydro must be available at all times during the construction process. One of the following systems must be operational at any given time during the construction works.
  - .1 The existing natural gas engine,
  - .2 Temporary bypass pumping provided by the Contractor as described in Specification section E3.
  - .3 The new natural gas engine provided under this contract.
- .2 The bypass pumping system must be available and proven operational before the existing engine can be disabled and removed.
- .3 The bypass pumping system must remain operational until the new engine is fully operational and accepted by the Contract Administrator.

### **1.11 Site Sanitation**

- .1 The pumping station, piping and wet wells contain raw sewage. Also the station and piping contains accumulated debris and sludge. The Contractor shall ensure that all sewerage and related debris is handled and disposed of in a safe and appropriate manner.
- .2 No claim by the Contractor shall be made with respect to Site sanitation.

### **1.12 Contractor Use of Premises**

- .1 Limit use of premises for Work, for storage, and for access, to allow for City operations to operate the pumping station.
- .2 There may be other Subcontractors working on the Site. Co-ordinate use of the Site with the Contract Administrator.
- .3 Obtain and pay for use of appropriate additional storage or Work areas needed for operations under this Contract.
- .4 Remove or alter existing Work to prevent injury or damage to portions of existing Work which remain.
- .5 Repair or replace portions of existing Work which have been altered during construction operations to match existing or adjoining work, as directed by Contract Administrator.
- .6 Execute Work with least possible interference or disturbance to building operations, and normal use of premises. Arrange with Contract Administrator to facilitate execution of Work.

### **1.13 Site Occupancy**

- .1 The City will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with The City in scheduling operations to minimize conflict and to facilitate The City's usage.

### **1.14 Existing Services**

- .1 Notify Contract Administrator of intended interruption of any service required in order to complete Work, and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Contract Administrator 48 hours notice for necessary interruption of mechanical or electrical service throughout course of Work. Minimize duration of interruptions.
- .3 Submit schedule to and obtain approval from Contract Administrator for any shut-down or closure of active service or facility including power services. Adhere to approved schedule and provide notice to Contract Administrator.

### **1.15 Documents Required**

- .1 Maintain at job Site, one copy of each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed Shop Drawings.
  - .5 List of Outstanding Shop Drawings.
  - .6 Change Notices and Change Orders.

- .7 Field Test Reports.
- .8 Copy of Approved Work Schedule.
- .9 Health and Safety Plan and Other Safety Related Documents.
- .10 Other documents as specified.

#### **1.16 Use Of Site And Facilities**

- .1 Execute Work with least possible interference or disturbance to normal use of premises. Make arrangements with Contract Administrator 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.

#### **1.17 Dangerous Work Conditions**

- .1 Further to clause C 6.24 of the General Conditions, the Contractor shall be aware of the potential hazards that can be encountered in the existing abandoned sewerage such as explosive gases, toxic gases and oxygen deficiency.
- .2 The air in an existing sewage pipe that is to be demolished may contain toxic or explosive gases. Care is required during disassembly to ensure they do not impact personnel.
- .3 The Contractor shall provide a photoionization detector (PID) on Site at all times to monitor potential hydrocarbon vapours. The gas detector and safety equipment conforming to the Act shall be made available to the Contract Administrator for his use during inspections.

#### **1.18 Building Smoking Environment**

- .1 Comply with smoking restrictions. Smoking is not allowed in any City buildings.

#### **1.19 Offices**

- .1 Subcontractors to provide their own offices as necessary.
- .2 Provide a heated, site trailer with electrical service for Contractor and Contract Administrator use. Trailer shall also be suitable for hosting site meetings. Provide suitable tables, chairs as required.

#### **1.20 Demolition and Waste Disposal**

- .1 Unless specified otherwise, all material no longer required at the Site, shall become the Contractor's property. Contractor may retain them for salvage value or dispose of them at an acceptable licensed disposal facility.

#### **1.21 Cleaning**

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

- .2 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .3 Clean-up work area as Work progresses.

## 1.22 Submittals Procedures

- .1 Administrative
  - .1 Submit to Contract Administrator for review. Submit with reasonable promptness and in orderly sequence so as not to 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. Work affected by submittals to proceed only after review is complete.
  - .2 Review submittals prior to submission to Contract Administrator. Stamp and sign submittals certifying review of submission. This review represents that necessary requirements have been checked and coordinated with requirements of Work and contract documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
  - .3 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of contract documents stating reasons for deviations.
  - .4 Verify field measurements and that affected adjacent work is coordinated.
  - .5 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
  - .6 Contractor's responsibility for deviation in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
  - .7 Keep one reviewed copy of each submission on Site.
- .2 Shop Drawings and Product Data
  - .1 Term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data provided by Contractor to illustrate details of 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 Submit 1 electronic copy (pdf) of all shop drawings.
  - .4 Submit 1 electronic copy (pdf) of product data sheets or brochures for requirements requested in Project Manual Sections and as requested by

- Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.
- .5 Adjustments made on shop drawings by Contract Administrator are not intended to change contract price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
  - .6 Make changes in shop drawings as Contract Administrator may require, consistent with contract documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.
  - .7 Accompany submissions with transmittal letter, containing:
    - .1 Date and revision dates.
    - .2 Project title and number
    - .3 Contractor's name and address
    - .4 Identification and quantity of each shop drawing, product data and sample.
    - .5 Other pertinent data.
  - .8 Submissions to include:
    - .1 Date and revision dates.
    - .2 Project title and number
    - .3 Name and address of Subcontractor, Supplier, Manufacturer.
    - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval so submission, 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, relation to adjacent structure or materials.
      - .3 Setting or erection details.
      - .4 Capacities.
      - .5 Performance characteristics.
      - .6 Standards.
      - .7 Operating weight.
      - .8 Wiring diagrams.
      - .9 Single line and schematic diagrams.
  - .9 After Contract Administrator's review, distribute copies to subtrades as required.
  - .10 Supplement standard information to provide details applicable to project.
  - .11 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copy 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.

### 1.23 Closeout Submittals

- .1 Project Record Documents
  - .1 Maintain at construction Site, two sets of white prints for record drawing purposes. Mark one set "FIELD DRAWINGS" and use to record initial data when field measurements are made. Mark other set "RECORD DRAWINGS".
  - .2 Store record drawings in field office apart from other documents used for construction. Maintain record drawings in clean, dry and legible condition. Do not use record drawings for construction purposes.
  - .3 Record "as-built" information in red ink, accurately and concurrently with construction progress. Do not conceal Work until required information is recorded.
  - .4 Legibly mark each item to record actual construction, including:
    - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
    - .2 Changes made by Addendum, Change Order or Field Instruction.
    - .3 Details not on original Contract Drawings.
    - .4 References to related shop drawings and modifications.
    - .5 At completion of project and prior to final inspection, neatly transfer "as-built" notations to second set of white prints and submit to Contract Administrator along with field drawings.
  - .5 Provide an electronic copy (PDF) of all final shop drawing in an orderly fashion on one CD.
- .2 Spare Parts, Maintenance Materials And Special Tools
  - .1 Provide items of same manufacture and quality as items in Work, and of same production run and dye lot as installed materials.
  - .2 Provide special tools with tags identifying their associated function and equipment.
  - .3 Keys and Maintenance Tools for Hardware and Specialties.
    - .1 Turn over to Contract Administrator all keys and special tools required for maintenance of all finish hardware, cabinet hardware, equipment, etc. (including electrical and mechanical products) such as lock wrenches, etc.
    - .2 Properly tag all keys and tools, giving names of equipment, hardware, or item to which they are used.
  - .4 Deliver all items to Site or location as directed by Contract Administrator.
  - .5 Receive and catalogue all items, and submit inventory listing to Contract Administrator. Include copy of inventory listing in Operation and Maintenance Manuals.
  - .6 Obtain receipt of delivered spare parts, maintenance and extra materials from Contract Administrator and submit with request for final payment.

- .3 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 paints and freezable materials in heated and ventilated room.
  - .4 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.
- .4 Operation And Maintenance Manuals
  - .1 Submit three (3) copies draft Operation and Maintenance Manual to Contract Administrator for review and comments. Submissions of individual data will not be accepted.
  - .2 Make changes as required.
  - .3 Prepare six (6) Final hard copies and one (1) Digital copy of Operation and Maintenance Manuals.
  - .4 Format.
    - .1 Organize data in form of an instructional manual.
    - .2 Binders: vinyl, hard covered, 3 "D" ring, loose leaf spine and fact pockets.
    - .3 When multiple binders are used, correlate data into related consistent groupings and identify contents of each binder on spine.
    - .4 Cover: identify each binder with printed title "Operation and Maintenance Manual". List title of project Bid Opportunity No. and identify subject matter of contents.
    - .5 Arrange content under Section numbers and sequence of Table of Contents.
    - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
    - .7 Text: manufacturer's printed data, or typewritten data.
    - .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pates.
  - .5 Contents (each volume).
    - .1 Table of Contents: provide title of project; date of submission; names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties; schedule of products and systems, indexed to content of volume.
    - .2 For each product of system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement arts.
    - .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 specified.
- .6 Equipment and Systems.
  - .1 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
  - .2 Include installed colour coded wiring diagrams.
  - .3 Operating Procedures: include complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number. Provide written explanation of operation of each system with instructions for trouble shooting of operational failures. Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control stopping, shut-down, and emergency instructions. Include any special operating instructions.
  - .4 Maintenance Requirements: include routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - .5 Provide servicing and lubrication schedule, and list of lubricants required.
  - .6 Include manufacturer's printed operation and maintenance instructions.
  - .7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
  - .8 Provide installed control diagrams by controls manufacturer.
  - .9 Provide Contractor's coordination drawings.
  - .10 Loop drawings.
  - .11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
  - .12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - .13 Include test reports as specified.
  - .14 Include one complete set of final reviewed and stamped shop drawings, copy of hardware and paint schedules, requirements specified in individual specification Sections.
- .8 At completion of project and prior to final inspection, submit to Contract Administrator, three (3) copies of Structural, Mechanical and Electrical Operation and Maintenance Manuals.
- .5 Warranties And Bonds
  - .1 Provide warranties and bonds as specified.
  - .2 Assemble warranties and bonds, executed by each of respective manufacturers, suppliers, and subcontractors.
  - .3 Provide Table of Contents neatly typed, in orderly sequence. Provide complete information for each item:
    - .1 Product or work item.
    - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
    - .3 Date of beginning of warranty or bond.

- .4 Duration of warranty or bond.
  - .5 Proper procedure in case of failure.
  - .6 Instances which might affect validity of warranty or bond.
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- .4 Except for items put into use with Contract Administrator's permission, leave date of beginning of time of warranty until Date of Total 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.
  - .8 Submit with Contractor's Application for Certificate of Total Performance, warranties and bonds as required, executed in duplicate by subcontractors, suppliers, and manufacturers.
  - .9 For items of Work, where acceptance is delayed materially beyond Date of Total Performance, provide updated submittal within 10 calendar days after acceptance, listing date of acceptance as start of warranty period.

#### 1.24 Engine Installation

- .1 Intent
  - .1 This Section describes general requirements for the engine supplied under the Contract relating to the supervision of installation, testing, operation, and performance verification. The Contractor shall be responsible for the supply, installation, testing, operation, and performance verification of the specified engine.
- .2 Definitions
  - .1 Manufacturer: the manufacturer is the person, partnership, or corporation responsible for the manufacture and fabrication of engine provided to the Contractor for the completion of the Work.
  - .2 Manufacturer's Representative: the manufacturer's representative is a trained serviceman empowered by the manufacturer to provide installation, testing, and commissioning assistance to the Contractor in his performance of these functions.
- .3 Expertise and Responsibility
  - .1 The Contract Administrator recognizes the expertise of the manufacturer.
  - .2 Should the Contract Administrator issue a Field Order, Authorization for Contract Change, or Instruction to Change the Work, which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two days.
- .4 Engine Delivery
  - .1 The engine shall be delivered to the construction Site to the Contractor who shall be responsible for taking delivery of the engine. Written acceptance of receipt, at delivery, by the Contractor shall constitute "Delivery to Site" under this Contract. A representative from each of the following groups will be in attendance at the

time of delivery: the Supplier, Contractor, and Contract Administrator. A duly executed "Certificate of Equipment Delivery" (Form 100) shall be completed. Any minor damage identified during the inspection shall be repaired as per the manufacturer's recommendations by the Contractor at no cost to the City. Any severe damage will be grounds for rejection of the engine. The severely damaged engine will be replaced at no cost to the City.

- .2 Ten days before delivery, notice shall be given to the Contract Administrator so that arrangements for receipt and for inspection can be made. The shipping lists of materials will be carefully checked by the supplier in the presence of the Contract Administrator and the Contractor.
- .3 The Contractor shall be responsible for receiving, off-loading, and placing the engine at the Site.
- .4 The Contractor shall ensure that he is fully informed of precautions to be taken in the unloading of engine and its subsequent storage.

.5 Installation Assistance

- .1 Before commencing installation of engine, the Contractor shall arrange for the attendance of the manufacturer's representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the engine.
- .2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any manufacturer's representative for installation training at least 14 days prior to arrival.
- .3 When the manufacturer's representative is satisfied that the Contractor is aware of all installation requirements, he shall so certify by completing Form 101 attached to this Specification.
- .4 The completed form shall be delivered to the Contract Administrator prior to departure of the manufacturer's representative from the Site.
- .5 Installation of the engine shall not commence until Contract Administrator has advised that he has received the completed Form 101.

.6 Installation

- .1 The Contractor shall install the engine as defined in the Specifications. If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.
- .2 If it is found necessary, or if so directed by the Contract Administrator, the Contractor shall arrange for the manufacturer's representative to visit the Site to provide assistance during installation, all at no cost to the City.
- .3 Prior to completing installation, the Contractor shall inform the manufacturer and arrange for the attendance at the Site of the manufacturer's representative to verify successful installation.

- .4 The manufacturer's representative shall conduct a detailed inspection of the installation including alignment, electrical connections, rotation direction, running clearances, lubrication, workmanship, and all other items as required to ensure successful operation of the engine.
  - .5 The manufacturer's representative shall identify any outstanding deficiencies in the installation.
  - .6 The deficiencies shall be rectified by the Contractor and the manufacturer's representative will be required to re-inspect the installation, at no cost to the City.
  - .7 When the manufacturer's representative accepts the installation, he shall certify the installation by completing Form 102, attached to this Specification.
  - .8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the manufacturer's representative from the Site.
  - .9 Tag the engine with a 100 mm by 200 mm card stating "Engine Checked. Do Not Run." stenciled in large black letters. Sign and date each card.
- .7 Operation and Performance Verification
- .1 Engine will be subjected to a demonstration, running test, and performance tests after the installation has been verified and any identified deficiencies have been remedied.
  - .2 Inform the Contract Administrator at least 14 days in advance of conducting the tests and arrange for the attendance of the manufacturer's representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.
  - .3 The manufacturer's representative will conduct all necessary checks to engine and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other Work needed prior to confirming the engine is ready to run.
  - .4 The Contractor shall then operate the engine for at least one hour to demonstrate to himself the operation of the engine and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.
  - .5 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the engine. The Contract Administrator shall attend, as expeditiously as possible.
  - .6 With the assistance of the manufacturer's representative, the Contractor will demonstrate that the engine is properly installed. Alignment, piping connections, electrical connections, etc., will be checked and if appropriate, code certifications provided.
  - .7 The engine shall then be run for one hour. Local controls shall be satisfactorily verified by cycling the engine through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or manufacturer's recommended limits, whichever is more stringent.

- .8 On satisfactory completion of the one-hour demonstration, the engine will be stopped and critical parameters, such as alignment, will be rechecked.
- .9 The engine will be restarted and run continuously for three days. During this period, as practicable, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the manufacturer's representative, the Contractor, and Contract Administrator on the basis of the information contained in the Specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.
- .10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the manufacturer's representative, and the Contractor.
- .11 Performance tests shall be as dictated in the Specifications for the engine or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.
- .12 The Contractor shall submit the results of the performance tests to the Contract Administrator, documented and summarized in a format acceptable to the Contract Administrator. The Contract Administrator reserves the right to request additional testing. The engine shall be accepted and handed over to the City prior to the satisfactory completion of the performance tests and receipt of the test reports.
- .13 All water, temporary power, heating, or any other ancillary services required to complete the initial demonstration, running test and performance tests are the responsibility of the Contractor.
- .14 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.
- .15 On successful completion of the demonstration, running test, and performance tests, Form 103 attached to this Specification will be signed by the manufacturer's representative, the Contractor, and the Contract Administrator.
- .16 The Contractor shall affix to the tested engine a 100 mm by 200 mm card reading "Operable Condition - Do Not Operate without Contractor's Permission." stenciled on in large black letters.

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**CERTIFICATE OF EQUIPMENT DELIVERY  
FORM 100**

We certify that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

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**CERTIFICATE OF READINESS TO INSTALL  
FORM 101**

I have familiarized the installer of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer / Supplier.

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_

\_\_\_\_\_

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**CERTIFICATE OF SATISFACTORY INSTALLATION  
FORM 102**

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_  
\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

**OUTSTANDING DEFECTS:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

**CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE  
FORM 103**

We certify that the equipment listed below has been continuously operated for at least three (3) consecutive days and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

Acknowledgement of Receipt of O&M Manuals.

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

## 1.26 Training

### .1 Description

- .1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the engine and systems installed under this Contract.
- .2 Training sessions are required during the engine testing.
- .3 As a minimum, the Contractor is to allow at least four hours of training per shift, as required for the engine system. Refer to the engine Specifications for specific time periods.
- .4 The intent is that the City should receive sufficient training on the engine and systems that they are going to operate and maintain. The Contract Administrator shall have the authority to determine the duration and content of each training session required.

### .2 Quality Assurance

- .1 Where required by the engine Specifications, provide on-the-job training of the City staff. Training sessions will be conducted by qualified factory-trained representatives of the engine supplier with a minimum of two years experience. Training includes instruction of City staff in engine operation and preventive maintenance and instruction on mechanics, electricians, instrumentation, and communications technicians in normal maintenance up to major repair.
- .2 The trainers proposed by the Contractor shall be experienced in training plant operators and shall have relevant experience in similar Work.

### .3 Submittals

- .1 Submit the following information in accordance with Section 1.23. For phased testing and start-up activities, separate submittals can be prepared for engine. The material will receive a "REVIEWED" or "REVIEWED AS MODIFIED" status by the Contract Administrator no later than four weeks prior to delivery of the training:
  - .1 Lesson plans and training manuals, handouts, visual aids, and other reference materials for each training session to be conducted by the Contractor's trainer(s).
  - .2 Date, time, and subject of each training session.
  - .3 Training schedule. Concurrent classes will not be allowed.

### .4 Location

- .1 Where specified, conduct training sessions for the City staff, operations and maintenance personnel, on the operation, care, and maintenance of the engine and systems installed under this Contract. Training will take place at the Site of the Work and under the conditions specified in the following paragraphs.

- 
- .2 Field training sessions will take place at the Site of the engine. Classroom training is to take place in the boardroom in the WEWPCC Boardroom. The Contract Administrator may direct the classroom training to take place at another suitable location.
  
  - .5 Lesson Plans
    - .1 Prepare formal written lesson plans for each training session and coordinate with the Contract Administrator. Lesson plans to contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan will contain a time allocation for each subject. Furnish ten (10) copies of necessary training manuals, handouts, visual aids, and reference materials at least two weeks prior to each training session.
  
  - .6 Format and Content
    - .1 Include time in the classroom and at the location of the engine for each training session. As a minimum, cover the following topics for the engine:
      - .1 Familiarization
      - .2 Safety
      - .3 Operation
      - .4 Troubleshooting
      - .5 Preventive maintenance
      - .6 Corrective maintenance
      - .7 Parts
      - .8 Local representatives
  
  - .7 Video Recording
    - .1 Advise all suppliers providing training sessions that the training material may be videotaped. The City may record each training session, and the material may be edited and supplemented with professionally produced graphics to provide a permanent record for the City's use.
  
  - .8 General Requirements
    - .1 Conduct training in conjunction with the engine testing period. Schedule classes such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on consecutive days, with no more than four hours of classes scheduled for any one shift.
    - .2 Provide final O&M Manuals, as defined in Section 1.24, for the specific engine to the City at least four weeks prior to the start of any training. (Video recording may take place concurrently with all training session).

.9 Operator Classroom Training

.1 As a minimum, classroom engine training for operations personnel will include:

- .1 The engine's specific location in the plant and an operational overview. Use slides and drawings to aid discussion.
- .2 Purpose and plant function of the engine.
- .3 The operating theory of the engine.
- .4 Start-up, shutdown, normal operation, and emergency operating procedures, including system integration and electrical interlocks, if any.
- .5 Safety items and procedures.
- .6 Routine preventive maintenance.
- .7 Operator detection, without test instruments, of specific engine trouble symptoms.
- .8 Required engine exercise procedures and intervals.
- .9 Routine disassembly and assembly of engine if applicable for purposes such as operator inspection of engine.
- .10 Exam.

.10 Operator Hands-On Training

.1 As a minimum, hands-on engine training for operations personnel will include:

- .1 Identifying instrumentation: location of primary element; location of instrument readout; discuss purpose, basic operation, and information interpretation.
- .2 Discussing, demonstrating, and performing standard operating procedures and daily visual inspection of system operation.
- .3 Discussing and performing the preventive maintenance activities.
- .4 Discussing and performing start-up and shutdown procedures.
- .5 Performing the required engine exercise procedures.
- .6 Performing routine disassembly and assembly of engine if applicable.
- .7 Identifying and reviewing safety items and performing safety procedures, if feasible.

.11 Maintenance Classroom Training

.1 Classroom engine training for the maintenance and repair personnel will include:

- .1 Basic theory of operation.

- 
- .2 Description and function of equipment.
  - .3 Routine start-up and shutdown procedures.
  - .4 Normal and major repair procedures.
  - .5 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
  - .6 Routine and long-term calibration procedures.
  - .7 Safety procedures.
  - .8 Preventive maintenance and up to and including major repairs such as replacement of major equipment part(s) with the use of special tools.
- .12 Maintenance Hands-on Training
- .1 Hands-on engine training for maintenance and repair personnel will include:
    - .1 Locating and identifying engine components.
    - .2 Reviewing the engine function and theory of operation.
    - .3 Reviewing normal repair procedures.
    - .4 Performing routine start-up and shutdown procedures.
    - .5 Reviewing and performing the safety procedures.
    - .6 Performing City approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting engine problems.
    - .7 Reviewing and using Contractor's manuals in the hands-on training.
- .13 Engine and Systems for Training
- .1 Provide training during the engine testing period for the following equipment:
    - .1 Natural gas engine system (Engine)
  - .2 Coordinate and finalize with the Contract Administrator on training schedules and duration of each training session.
- .14 Training Completion Forms and Payment
- .1 Training for the Contract supplied engine shall be conducted before the operation period as described in Form 103, included in Section 1.25.
  - .2 The Contract shall not be considered complete, for the purpose of issuing a Certificate of Substantial Performance, until the training has been provided and Form 103 has been completed and signed.

- .3 Form T1: to be completed for initial training. One (1) form is to be used for the engine.
- .4 Form T2: to be completed for training during the warranty period. One (1) form is to be used for engine/system for which training has been provided.
- .5 Payment for this Work will be released only when the training has been completed to the City's satisfaction and the respective forms are signed.
- .6 A sample of Forms T1 and T2 are attached to this Specification Section.

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**CERTIFICATE OF SATISFACTORY TRAINING  
FORM T1**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Trainer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

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**CERTIFICATE OF SATISFACTORY TRAINING  
FORM T2**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Trainer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

## 1.27 Commissioning

### .1 General

- .1 At the time of commissioning, the Contract Administrator shall advise the Contractor of commissioning requirements.
- .2 The Contractor shall refer to all Sections for details on commissioning procedures not included in this Section.

### .2 Intent

- .1 This Section describes the Contractor's responsibilities in commissioning and handover of the process, electrical, and other systems to be installed as part of this Work.

### .3 Definitions

- .1 System: for the purpose of this Specification Section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.
- .2 Commissioning: for the purpose of this Specification Section, commissioning shall be defined as the successful operation of a system in accordance with its design requirements for a period of 7 days.
- .3 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City for his operation and maintenance. This shall occur after the successful end of commissioning of each system through a formal agreement between the Contract Administrator, the City, and the Contractor. Success of the commissioning period is determined by the Contract Administrator.

### .4 Commissioning Team

- .1 The Work of commissioning will be conducted by the Contractor, the City, and the Contract Administrator.
- .2 The City's appointed staff shall represent process personnel and operating staff.
- .3 The Contractor shall provide personnel representing the appropriate trades, including I&C personnel during the commissioning. These personnel shall be skilled workmen, able to expedite any minor repairs, adjustments, etc., as required to complete commissioning with as few delays as possible.

### .5 Commissioning Plan

- .1 Develop a detailed methodology for the commissioning of each system at least 30 calendar days prior to planned start of commissioning. The plan shall be drafted by the Contractor and reviewed by the Contract Administrator and include the following:

- 
- .1 Detailed schedule of events, including but not limited to the schedule for completion of testing of all component parts of the system in accordance with Section 1.25 prior to commissioning of a system.
  - .3 Planned attendance schedule for manufacturer's representatives.
  - .4 Contingency plans in the event of a process malfunction.
  - .5 Drawings and sketches as required to illustrate the planned sequence of events.
  - .6 List and details for any temporary equipment required to facilitate Commissioning.
  - .7 List of all personnel required for commissioning and handover with information indicating their qualifications for this Work.
- .2 The commissioning plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.
- .6 Equipment
- .1 All process, mechanical, electrical, control, and miscellaneous equipment related to a system shall be successfully installed and tested in accordance with Section 1.25 and any specific requirements noted in other Sections. Form 103 shall be executed for each item.
  - .2 As required in Section 1.24, O&M Manuals will be submitted and then reviewed by the Contract Administrator.
  - .3 Staff training sessions shall be completed.
  - .4 Temporary equipment will be installed and tested as necessary to ensure that it functions reliably and consistently through the commissioning period.
- .7 Controls
- .1 All controls which are the responsibility of this Contractor shall be installed and tested prior to commissioning.
  - .2 The Contract Administrator shall arrange for the simulation of the control sequences from the equipment under this scope. Every effort shall be made to ensure that the commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.
- .8 Manpower
- .1 Supply all staff required during commissioning as necessary to assist the City's staff in the operation of the station.

- 
- .2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the commissioning period.
  - .3 Ensure equipment manufacturer's representatives are available as necessary to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.
- .10 Design Parameters
- .1 Design parameters for the systems to be commissioned shall be as defined in the Specifications and/or the operating descriptions. The commissioning team will identify to the Contractor, which parameters shall be modified prior to commissioning and shall be responsible for any subsequent changes during the commissioning period.
- .11 Preparation
- .1 Each item of equipment included in the system to be commissioned shall be satisfactorily tested and Form 103 completed.
  - .2 Piping, wiring, and other conduit systems shall be finished and tested.
  - .3 Electrical connections shall be completed and inspected to the satisfaction of the governing authorities.
  - .4 All other regulatory inspections shall be completed to the satisfaction of the governing authorities.
  - .5 Control systems shall be completed and the related control software debugged.
- .12 Sequence
- .1 Systems shall be commissioned in a logical manner. Upstream components shall be commissioned first to the degree possible.
  - .2 The following sequence of events shall be followed:
    - .1 O&M Manuals shall be available as per the requirements of Section 1.24 at least 14 days prior to the start of commissioning.
    - .2 Initial operator training shall be undertaken two weeks prior to commissioning.
    - .3 Equipment performance tests shall be conducted successfully.
    - .4 Start and run system in manual mode.

- 
- .5 Turn equipment to automatic in a planned and logical manner. Ensure that the control system is operating the equipment in a manner which precludes damage of the equipment and which is consistent with the process operating requirements.
  - .6 Commence commissioning period of 7 days. The equipment shall operate continuously and successfully through this period. Minor failures shall not void the commissioning period. A minor failure is defined as one which does not present a safety hazard, does not impact overall process functioning and can be temporarily overcome by the use of available standby equipment. The commissioning period shall be re-started if a critical failure occurs.
  - .7 Upon completing the commissioning period, the system shall be granted formal acceptance by the Contract Administrator.
- .13 Commissioning
- .1 Water will be introduced to the system in a manner which precludes the damage of any equipment or structures.
  - .2 Twice during the commissioning period, plant component settings will be modified to ensure that the system is subjected to flows and loads as close to design conditions as possible. Where necessary to achieve this, flows to the area being commissioned will be augmented to exaggerate the naturally occurring flows and loads. Where it is necessary to modify settings outside the limits of this Contract area within the station, coordinate the changes with plant staff.
  - .3 All components and systems shall be operated in the automatic/manual and the remote/local modes as required to prove proper operation.
  - .4 Ensure all bypasses and backup provisions function satisfactorily.
  - .5 All minor and major alarm conditions will be induced to ensure that the process reacts as intended and the applicable alarms are annunciated.
- .14 Acceptance
- .1 The commissioning of a system shall be considered acceptable when the process has operated in a stable manner, satisfying the design criteria for a period of 7 days.
  - .2 When a process system has been commissioned satisfactorily, the process system shall be formally accepted for operation and routine maintenance by the City's forces. On successful completion of commissioning, Form 104 - Certificate of Satisfactory Process Performance attached to this Specification will be signed by the representative of the manufacturer, Contractor, Contract Administrator, and the City.
  - .3 An acceptance meeting must be held at the end of the test to confirm the status of each system.

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**CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE  
FORM 104**

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its performance testing criteria. The equipment is therefore classed as "conforming".

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG No(s):** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City of Winnipeg)

\_\_\_\_\_  
Date

## **PART 1 GENERAL**

### **1.1 Intent**

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 In general, Work in this Division includes:
  - .1 Demolish existing natural gas engine and install new engine and related systems.
- .3 Drawings are diagrammatic. 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 requirements of Contract Documents.
- .5 Connect to equipment specified in other Sections. Uncrate equipment, move in place, install complete; start-up and test.
- .6 'Provide' shall mean; "supply and install".
- .7 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 100000 shall apply to Work in Division 23.

### **1.2 Co-ordination of Work**

- .1 Make reference to electrical, mechanical and structural drawings when setting out Work. Jointly resolve all conflicts on-site before fabricating or installing any materials or equipment.
- .2 Accuracy of dimensions for new piping, valves and other equipment items is the Contractor's responsibility. Any fit issues between Site conditions and new materials to be installed remain with the Contractor.
- .3 Where dimensional details are required, collect Site dimensions.

### **1.3 Quality of Work**

- .1 All Work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates.
- .2 Work which does not conform to standards accepted by the Contract Administrator and the trade may be rejected.

### **1.4 Quality Assurance**

- .1 Quality assurance submittals: submit following in accordance with Section 100000, item 1.23 - Submittals Procedures.

- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Contractor's COR Safety Program and requirements of authority-having-jurisdiction.

### **1.5 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Dispose of unused paint and coating material at official hazardous material collections Site approved by Authorities having Jurisdiction.
  - .2 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

### **1.6 Manufacturer's Equipment Nameplates**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **1.7 System Nameplates**

- .1 Colours:
  - .1 Hazardous: red letters, white background
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

### **1.8 Existing Identification Systems**

- .1 Apply existing identification system to new Work.
- .2 Where existing identification system does not cover for new Work, use identification system specified in this section.
- .3 Before starting Work, obtain written approval of identification system from Contract Administrator.

**1.9 Manufacturer's Instructions**

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

**1.10 Installation**

- .1 Perform Work in accordance with CAN/CGSB-24.3 except as specified otherwise.

**1.11 Nameplates**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Protection:
  - .1 Do not paint or cover.

~End~

**PART 1                      GENERAL**

**1.1      General**

.1      Section 230500 shall apply to work in this section.

**1.2      Description of System & Site**

.1      Provide a natural gas engine to deliver standby drive to a right angle drive that drives a sewage pump when there is a power failure and the pump's primary 100 hp electric motor drive cannot run. The engine system shall include a liquid cooled engine, and system controls with all necessary accessories for a complete operating system, including the items as specified hereinafter.

**1.2      Requirements of Regulatory Agencies**

- .1      Conform to applicable CSA requirements.
- .2      Conform to Gas Code CAN/CSA B149.1.

**1.3      Manufacturer Qualifications**

- .1      This system shall be supplied by an original equipment manufacturer (OEM) who has been regularly engaged in the production of natural gas engines.
- .2      The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
- .3      Manufacturer's authorized service representative shall meet the following criteria:
  - .1      Certified, factory trained, technicians
  - .2      Service support 24/7
  - .3      Service location in Winnipeg
  - .4      Service & repair parts in-stock
  - .5      Offer optional remote monitoring and diagnostic capabilities

**1.4      Submittals**

- .1      Engine specification sheet
- .3      Controls specification sheets
- .4      Installation / Layout dimensional drawings
- .5      Wiring schematics
- .6      Sound data
- .7      Emission certification
- .8      Warranty statement
- .9      Alternator thermal damage and decrement curves

**1.5      Acceptable Manufacturers**

.1      Acceptable engine manufacturers include:

- .1 Toromont
- .2 General Motors
- .3 Ford

## 1.6 Owner's Manuals

- .1 Three (3) sets of owner's manuals and one electronic copy on CD, DVD or USB flash drive, specific to the product supplied must accompany delivery of the equipment. General operating instructions, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included. Also provide list of recommended spare parts.

## 1.7 Warranty

- .1 The engine shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five (5) years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for parts, labour and travel.
- .2 The warranty period shall commence when the system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

## PART 2 PRODUCTS

### 2.0 ENGINE

#### 2.1 Engine Rating and Performance

- .1 The prime mover shall be a liquid cooled, natural gas fuelled engine of 4-cycle design. It will have 100 hp shaft output at 2700 RPM.

#### 2.2 Engine Oil System

- .1 Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).
- .2 The oil shall be cooled by an oil cooler which is integrated into the engine system.
- .3 Provide an engine drain valve and hose to simplify engine oil draining.

#### 2.3 Engine Cooling System

- .1 The engine is to be cooled with an engine mounted once through domestic water to engine glycol heat exchanger. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The

heat exchanger shall be designed for operation in 10 C to 50 C ambient temperatures.

- .3 Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.
- .4 Provide belt guards for personnel safety that meet UL and OSHA safety requirements.

## **2.4 Engine Starting System**

- .1 Starting shall be by a solenoid shift, DC starting system.
- .2 The engine's cranking batteries shall be lead acid. Provide 2 – 12 volt batteries in series. The batteries shall be the largest available by the manufacturer for this engine size. The batteries supplied shall meet NFPA 110 cranking requirements of 90 seconds of total crank time. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.
- .3 The engine shall have an engine driven battery charging alternator with integrated voltage regulation.
- .4 The engine shall have an automatic dual rate, float equalize, 10 amp 24 volt battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the engine controls to support remote monitoring and diagnostics. The battery charger is to be factory installed on the engine.

## **2.5 Engine Fuel System**

- .1 The engine fuel system shall be designed for operation on natural gas.
- .2 Provide engine flexible fuel line connectors.

## **2.6 Engine Exhaust & Intake**

- .1 The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. All components must be properly sized to assure operation without excessive back pressure when installed.
- .2 The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements. The silencer shall be selected to achieve acceptable site sound levels.
- .3 All exhaust piping from the engine to the silencer shall be thermally wrapped to minimize heat dissipation inside the station.
- .4 The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.

## 2.7 Controls

- .1 The engine control system shall be a fully integrated microprocessor based control system for standby emergency engines meeting all requirements of NFPA 110 level 1.
- .2 The engine controller shall provide integrated and digital control over all engine functions including: engine protection, alternator protection, speed governing, and all related engine operations. The engine controller must also provide seamless digital integration with the engine's electronic engine control module (ECM) if so equipped.
- .3 The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.
- .4 Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.
- .5 Provide a predictive maintenance algorithm that energizes an alarm contact when maintenance is required.
- .6 Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, and simultaneous monitoring of all input or output parameters.
- .7 In addition to standard NFPA 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.
- .8 The control system shall provide Form C dry contact outputs for the following:
  - .1 Low fuel outputs;
  - .2 Overspeed alarm;
  - .3 Oil pressure alarm;
  - .4 Water temperature alarm;
  - .5 Overcrank alarm;
  - .6 Engine running;
  - .7 Switch in auto status at a minimum and Modbus/TCP.
- .9 Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the engine controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.
- .10 The control panel will display all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; engine speed; DC battery voltage; run time hours.

- .11 Hand – off – auto switch to permit manual start of the engine if required. In auto, the engine shall start based on a request to start contact.
- .12 Engine shall have an electronic engine control module (ECM) to monitor and control engine functionality. All ECM fault codes shall be displayed at the generator controller in standard language – fault code numbers are not acceptable.
- .13 Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.
- .14 Control circuit preferred voltage shall be 24 VDC so that the existing station PLC panel may be powered from the new engine batteries during a power outage.

## **2.8 Engine / Alternator Packaging**

- .1 The engine/alternator shall be isolated with rubber isolators.

## **2.9 Other**

- .1 Provide engine mounted on painted steel frame.
- .2 Provide automatic speed governor.
- .3 Include overcrank protection.
- .4 Include automatic safety shutoff valve that shuts off fuel if the engine stops.
- .5 Engine shall accommodate silencer and related exhaust gases discharge piping as shown on the drawings.
- .6 Engine rotation shall be CCW when viewing the engine from the flywheel/drive end.

## **PART 3 EXECUTION**

### **3.1 Factory Testing**

- .1 Before shipment of the equipment, the engine shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:
  - .1 Load test for 30 minutes.

### **3.2 Shipment**

- .1 Ship the engine assembled to the greatest extent possible. Clearly define in your quotation, any assembly work that must be done in the field by others. Provide clear instructions as to engine handling and installation procedures.

### **3.3 Installation**

- .1 Square engine with the right angle drive shaft to within 1 degree.

### **3.4 Start-Up and Checkout**

- .1 The supplier of the engine and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial start-up inspection to include:
  - .1 Ensure the engine starts (both hot and cold) within the specified time.
  - .2 Verification of engine parameters within specification.
  - .3 Test all automatic start-ups and shutdowns of the engine.
  - .4 Perform a load test of the engine.

~End~