METROLINX

Inverter, Rectifier and Charger Specification

Specification 26 33 33

Revision 01
Date: March 2023

Inverter, Rectifier and Charger Specification

Specification 26 33 33

Publication Date: August 2018
Revision date: March 2023

an Agency of the Government of Ontario

Amendment Record Sheet

Amendment in Clause No.	Date of Amendment	Description of Changes
Cover Page	March 2023	Removed 'Capital Projects Group' to reflect organizational changes
1.2.3.	March 2023	Added: 'the latest version of'
1.2.6., 1.2.12, 1.2.13, 1.3.3	March 2023	Updated design requirements and numbering on Electrical Identification and Nomenclature Specification
3.1, 3.2	March 2023	Updated execution section

LIST OF CONTENT

1. GENERAL

1.1. SCOPE OF WORK

1.1.1. Design, labour, Products, equipment and services necessary for Inverter, Rectifier and Battery Charger Work.

1.2. DESIGN REQUIREMENTS

1.2.1. The equipment furnished and the equipment installation, wiring methods and materials used shall conform to the latest edition of the Ontario Electrical Safety Code, Electrical Safety Authority (ESA) Bulletins and Supplements issued by the Electrical Safety Authority, and the applicable Metrolinx Standards. In case of any conflicts, the more stringent requirement shall apply.

1.2.2. Design equipment and systems to all applicable standards of CSA, ULC, IEEE, ESA.

1.2.3. Design equipment and systems to the latest version of GO DRM.

1.2.4. Design equipment and system to be integrated into the Building Automation System (BAS) for monitoring and control of critical signals. Refer to BAS specification 25 05 10 for further information.

1.2.5. Design equipment and systems to standards and codes of the latest editions adopted by and enforced by local authorities having jurisdiction (AHJ).

1.2.6. Each site will consist of a central site inverter, rectifier, and charger system located in the main electrical room with the exception of device chargers located at devices (if applicable) as well as solar inverters and rectifiers shall be provided in a separate room.

1.2.7. Provide reliable source of power and operate during utility line deficiency without any interruptions of power supplied to load. Transfer from utility power to battery to utilize true no break system, (digitally generated sine wave, pulse width modulated output system) to maintain zero transfer time.

1.2.8. Operate from 5-100% loading, and rated to deliver full kVA rating, at unity power factor, for minimum of 60 minutes.

1.2.9. Utilize boost-tap transformer circuit to provide regulated output, during brownouts within +/-5% of incoming line voltage, without transferring to battery. Upon return of normal AC utility line power, system to recharge batteries within 12 hours without any interruptions of power supplied to load. Upon inverter failure, load to automatically connect to AC utility line.

1.2.10. Emergency Lighting Inverter System

a) Furnish and install Emergency Lighting Inverter System to supply minimum 50 kVA at 60 Hz for period of 60 minutes upon interruption, brownout, or failure of monitored AC utility line.

b) Emergency Lighting Inverter to be approved by BMEC or CCMC.

c) Emergency Lighting Inverter to supply continuous, regulated AC power at rated kVA to emergency and exit lights, other life safety loads, any other critical voltage or frequency sensitive loads.

d) Emergency Lighting Inverter with input voltage other than 600 V AC, 3 phase to be provided with a stand-alone K-rated transformer to match utility voltage and Emergency Lighting Inverter input voltage and kVA ratings.

e) Life Safety Emergency Power system shall be certified for this application. Life Safety Emergency Power system shall be designed to provide the providing the necessary egress lighting and other life safety requirements for the site's present and known future loads plus an additional 50% of spare capacity.

f) Designed to CSA C22.2 No. 141.

1.2.11. Solar inverter, or Photovoltage Inverter, or Solar Converter

a) A solar inverter, or photovoltaic inverter, or solar converter (Inverters), shall convert the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility voltage and frequency alternating current (AC) required for site equipment or feed back to the utility grid.

b) Inverters shall be designed with all the special functions adapted for use with photovoltaic arrays, including maximum power point tracking and anti-islanding protection. The inverter shall meet the requirements for the solar panel array and the AC voltage of the site's service.

c) Inverters shall be designed to conserve energy by being able to shut-off in periods when there is insufficient light to generate electricity.

d) Inverters and converters shall have front mounted LED displays that provide information such as:

1) Vac: Utility Voltage (V);

2) Vdc: Panel voltage (V);

3) Pac: Panel Power (W);

4) On/Off; and

5) A signal indicating connection to a monitoring platform;

1.2.12. Inverters are to come installed with capabilities to be able to connect to a monitoring platform such as a Building Automation System.

1.2.13. Inverters are to be warrantied for 10 years from installation.

1.2.14. Chargers

a) The charger shall be designed to meet the requirements of the battery it is to charge. The charger is to be designed to provide the maximum life possible for that type of battery.

b) The chargers will vary in size, time to charge and type depending on battery and charging time for that the application, be it charging a car battery or a generator battery, emergency battery pack, etc.

c) Charger shall be software controlled, temperature compensated, three-step float type charger, with equalize charging capability. Charger shall charge batteries continuously during normal standby condition. Following power failure charger to start in constant current mode until battery voltage reaches equalizing voltage. Equalizing voltage shall be maintained until charging current drops to 0.5 amps or 3% of battery amp/hour rating; battery voltage shall then be allowed to drop down to Float level. Recharge time shall be at most 12 hours per CSA C22.2 No. 141.

1.2.15. Batteries

a) Batteries shall provide sufficient power to maintain output voltage of inverter for minimum period of 1.0 hour (60 minutes) without dropping below 87.5% of nominal battery voltage. Batteries shall be enclosed in a cabinet permitting easy maintenance without requiring removal. Batteries shall be one of following types:

1) Lead-calcium, sealed, valve-regulated type;

2) Lithium-ion type; or

3) Nickel-Cadmium type.

1.3. RELATED WORKS

1.3.1. Section 25 05 10 – Building Automation Systems.

1.3.2. Section 26 05 21 – Electrical Conductors and Cables

1.3.3. Section 26 05 53 – Electrical Identification and Nomenclature

1.3.4. Section 26 05 00 - Electrical General Requirements.

1.3.5. Section 26 33 53 - Uninterruptible Power Supply.

1.4. REFERENCE STANDARDS

1.4.1. Ontario Electrical Safety Code (OESC).

1.4.2. Ontario Building Code (OBC).

1.4.3. Metrolinx Standards, Drawings and Specifications.

1.4.4. GO Design Requirement Manual (DRM).

1.4.5. Metrolinx Electrical Safety Document.

1.4.6. CSA Z462, Workplace Electrical Safety.

1.4.7. ANSI C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

1.4.8. ANSI C62.45 (Cat. A & B), Low-Voltage AC Power Circuits, Guide on Surge Test.

1.4.9. Building Code Act, Building Materials Evaluation Commission (BMEC).

1.4.10. Building Code Act, Canadian Construction Material Centre (CCMC).

1.4.11. CAN/CSA C22.2 No. 107.1-M91, Commercial and Industrial Power Supply Equipment.

1.4.12. CAN3 C235, Preferred Voltage Levels for AC Systems, 0 to 50,000V.

1.4.13. CAN3-Z299.4, Quality Assurance Program - Category 4.

1.4.14. CSA C22.2 No. 141, Emergency Lighting Equipment.

1.4.15. CSA C22.2 No. 107.3, Uninterruptible Power Systems.

1.4.16. CSA, Certification Standards and Electrical Bulletins.

1.4.17. EEMAC, Electrical and Electronic Manufacturer's Association Canada.

1.4.18. IEEE, Institute of Electrical and Electronics Engineers.

1.4.19. National Building Code of Canada, Canadian Construction Material Centre (CCMC).

1.4.20. NEMA, National Electronic Manufacturers Association.

1.4.21. SSPC, Surface Preparation Standards.

1.4.22. ULC, Underwriters' Laboratories of Canada.

1.5. SPARE PARTS

1.5.1. Not applicable.

1.6. TRAINING

1.6.1. Not applicable.

1.7. WARRANTY

1.7.1. The contractor shall provide a manufacturer warranty for the work of this section with a minimum warranty period of five years after acceptance by Metrolinx.

1.7.2. The contractor shall provide a manufacturer battery warranty for the work of this section with a minimum warrant period of three year full and seven year pro-rated under full float operation (totaling 10 years). In the case of Lithium Ion batteries, a full ten (10) year warranty under full float operation shall be provided without pro-rating.

1.8. DELIVERY, STORAGE AND HANDLING

1.8.1. Shipping and handling in accordance with manufacturer's printed instructions.

1.8.2. Preparation for shipment to include protection of equipment and accessories against corrosion, dampness, breakage, or vibration injury in transportation and handling. Package to prevent tampering or pilfering and approved and accepted by transportation companies.

1.8.3. Furnish necessary bus connections, wire jumpers, bolts, nuts, washers, etc., suitably packaged and marked to facilitate field assembly. Identify each shipping container with name of contents, Contract number, Substation Name and equipment number permanently marked and readily visible.

1.9. SUBMITTALS

1.9.1. Product Data

a) Submit manufacturer's Product data indicating:

1) Technical data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items, and parts lists;

2) Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol;

3) Product transportation, storage, handling, and installation requirements;

4) System configuration with single-line diagrams;

5) Functional relationship of equipment including weights, dimensions, and heat dissipation;

6) Descriptions of equipment to be furnished;

7) Size and weight of shipping units to be handled by installing contractor;

8) Detailed layouts of customer power and control connections; and

9) Detailed installation drawings including all terminal locations

1.9.2. Shop Drawings

a) Submit manufacturer's shop drawings indicating:

1) Computer link capabilities of system;

2) Centralized management and control configuration schematic and specifications;

3) Connection and integration to a monitoring platform such as a Building Automation System;

4) Connection to remote alarm panel annunciator or monitor screen; and

5) One (1) hard and soft copy each of the instruction manual to include functional description of equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.9.3. Commissioning Package

a) Submit the following:

1) Commissioning Plan;

2) Commissioning Procedures; and

3) Certificate of Readiness.

1.9.4. Commissioning Closeout Package

a) Submit the following:

1) Deficiency Report; and

2) Commissioning Closeout Report.

1.9.5. Closeout Submittals Package

a) Submit the following:

1) Identification: Manufacturer's name, type, year, serial number, number of units, capacity, and identification of related systems;

2) Functional description detailing operation and control of components;

3) Performance criteria and maintenance data;

4) Operating instructions and precautions;

5) Safety precautions;

6) Component parts availability including names and addresses of spare part suppliers;

7) Copies of factory test reports and copies of tests from an accredited test laboratory and third-party inspection agencies indicating the Work is in compliance with ESA, BMEC or CCMC;

8) Copies of shop and on-Site inspection reports; and

9) Submit As-Built Drawings.

1.10. QUALITY ASSURANCE

1.10.1. Installers' qualifications: Perform work of this Section by (manufacturer approved) skilled, qualified, and experienced workers trained in installation of Work of this Section.

1.10.2. Retain a Professional Engineer, licensed in the Province of Ontario, with experience in Work of comparable complexity and scope, to perform following services as part of Work of this Section:

a) Review, stamp, and sign fabrication and erection Shop Drawings, design calculations, and amendments;

b) Conduct shop and on-Site inspection and prepare inspection reports verifying Work in accordance with Contract Documents and reviewed Shop Drawings; and

c) Monitor supplier's and fabricator's quality control test and reports for compliance with Contract Documents.

2. PRODUCTS

2.1. GENERAL

2.1.1. The equipment furnished and the equipment installation, wiring methods and materials used shall conform to the latest edition of the Ontario Electrical Safety Code, Electrical Safety Authority (ESA) Bulletins and Supplements issued by the Electrical Safety Authority, and the applicable Metrolinx Standards. In case of any conflicts, the more stringent requirement shall apply.

2.1.2. The equipment shall be able to withstand the environmental conditions in the location of installation without damage or degradation of operating characteristics. Refer to Section 26 05 00.

2.1.3. All materials of the Rectifiers, Inverters and Chargers shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing.

2.1.4. All active electronic devices shall be solid-state. All power semiconductors shall be sealed.

2.1.5. Control logic components and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat.

2.1.6. Combination of separate Rectifiers, Inverters and Chargers to form a backup system are acceptable if they can meet the design requirements of guaranteed, low maintenance supply of emergency power to a load. However, such combinations shall not be used for providing backup power and a clean power source (filter) for critical electronics and life safety. Double Conversion online UPS design is the method that shall be used for providing backup power and a clean power source (filter) for critical electronics. Refer to Section 26 33 53.

2.2. EMERGENCY LIGHTING INVERTER SYSTEM

2.2.1. System Features

a) True “no-break” power to loads.

b) All components (rectifier, inverter, batteries and charger) shall meet the respective components in Section 26 33 53 requirement unless permitted in this Section.

c) Minimum 50,000 RMS symmetrical ampere short-circuit rating.

d) Inverter load versatility – lighting, fire, security, communication systems, building management system, motors and other critical loads.

e) Microprocessor control allows completely automatic self-diagnostic operation to warn of potential problems.

f) Automatic self-testing and test logging as required by code.

g) Battery runtime at full load minimum 60 minutes.

h) Display panel monitors and controls all parameters.

i) Only front access required for service.

2.2.2. Electrical Specifications

a) Input

1) Input voltage: three-phase, 3 or 4 wire, 600 V AC or 208V AC, + ground, + 10% -15%.

2) Input frequency: 60 Hz ± 5%.

3) Synchronizing slew rate: 1 Hz per second nominal.

4) Meets ANSI 62.41, CSA C22.2 No. 141 and CSA C22.2 No. 107.3 requirements.

b) Output

1) Output voltage: three-phase, 4 wire, + ground, 600 V AC or 208V AC + 10% -15%.

2) Output voltage regulation: ± 5% based on a 5 - 100% load.

3) Output frequency: normally synchronized to utility, + .05 Hz during emergency operation.

4) Overload: 150% momentary. 120% for five minutes.

5) Time to transfer to inverter after a utility power failure: No break.

2.3. WIRING

2.3.1. Wiring practices, materials and naming in accordance with requirements of the OESC and Specifications 26 05 21 and 26 05 53.

2.3.2. All bolted connections of bus bars, lugs, and cables in accordance with requirements of the OESC and other applicable standards.

2.3.3. All electrical power connections to be torqued to required value and marked with visual indicator as per Specification 26 05 53.

2.3.4. Make provision for cables to enter or leave from top or bottom of cabinets.

2.3.5. Wiring shall be installed in conduit and sized as required to assure proper operation of connected loads. Input and output wiring shall enter cabinet in separate conduits

2.3.6. All field wiring power connections shall be to tin-plated copper busbars for connection integrity. Busbars shall have adequate space to allow two-hole, long-barrel, compression type lugs forming a permanent connection between field wiring and field-installed lugs.

2.3.7. Provisions shall be made in the cabinets to permit installation of input, output and external control cabling using raceway or conduit. Provision shall be made for top and bottom access to input, output, bypass and DC connections.

2.4. SYSTEM MONITORING

2.4.1. Continuous scrolling display of following meter functions shall be provided:

a) Input AC voltage;

b) Output voltage;

c) AC output amps;

d) Battery voltage;

e) Battery charging amps;

f) Battery discharge amps;

g) Output volt-amps (VA);

h) Output power (Watts);

i) Power factor, percent loading;

j) Input frequency;

k) Output frequency;

l) Ambient temperature;

m) Battery temperature;

n) Last inverter run time;

o) Total inverter run time;

p) System run time; and

q) Date and time.

2.4.2. Capability to display all other meter functions via menu driven display, or "Hot Key" commands.

2.4.3. Completely microprocessor controlled providing continuous monitoring of all sub-systems to ensure system operational in emergency situations.

2.4.4. Alarms

a) Audible and visual alarms with automatic logging of most recent events. Alarm acknowledgment feature to enable user to silence only current audible alarm(s) without silencing other alarms, or clearing alarming condition until fault addressed. As a minimum, alarms to monitor:

1) Low battery voltage;

2) High battery voltage;

3) High AC input voltage;

4) High AC output voltage;

5) Low AC output voltage;

6) Output volt-amp overload;

7) Low run time left;

8) High ambient,

9) Battery temperatures;

10) System test failure; and

11) Circuit breaker tripped.

2.5. MATERIALS

2.5.1. Busbars: Copper tin-plated.

2.5.2. Steel sheet: ASTM A653, coating designation Z275; galvanized steel sheet.

2.5.3. Enclosure for indoor application: Heavy Duty NEMA 1, fabricated from galvanized steel sheet complete with heavy duty floor. The artitions and baffles shall be made of the same material as the enclosure. Rubber vibration pads shall be installed at mounting locations. Include drip shields and provide provisions for lifting and transporting. Equipment shall be suitable for floor mounting.

2.5.4. Knockouts for field installation: bushings and conduits in locations as required.

2.5.5. Wall mounting brackets and fasteners: galvanized to suit site conditions.

2.5.6. Terminal, winding, ground bus and conductor material: copper.

2.5.7. Fasteners: Galvanized expansion bolt type.

2.5.8. Batteries to meet requirements of Section 26 33 53 Uninterruptible Power Supply.

3. EXECUTION

3.1. FACTORY ASSEMBLY AND VERIFICATION

3.1.1. Assemble all components system in factory to ensure components fit together in proper manner.

3.1.2. Test assembled system in factory to ensure proper operation.

3.1.3. Manufacturer or Commissioning agent(s) to provide Metrolinx with FAT report.

3.2. INSTALLATION

3.2.1. Installed to manufacturer's installation instructions and in compliance with codes and Contract Documents.

3.2.2. Factory service representative to perform initial start-up of system at no additional cost to Metrolinx.

3.2.3. Metrolinx or its designated representative(s) to witness the Site Acceptance Test (SAT) and System Integration Test (SIT). Manufacturer or Commissioning agent(s) shall provide Metrolinx with SAT and SIT report.

END OF SECTION