PART 1 GENERAL

1.1 SUMMARY

.1 This specification shall define the electrical and mechanical characteristics and requirements for a continuous-duty, single-phase, solid-state uninterruptible power supply (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.
.2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C813.1-01, Performance Test Method for Uninterruptible Power Supplies.
.2 American National Standards Institute (ANSI)
.1 ANSI C62.41 - IEEE Standard 587, Guide on Surge Voltages in AC Power Circuits Rated up to 600V
.3 International Electrotechnical Commission (IEC)
.1 IEC 61000-4-2 – Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test.

1.4 SYSTEM DESCRIPTION

.1 The UPS shall be designed to operate as a true on-line double conversion system in the following modes:
.1 Normal: In normal operation incoming AC power shall be fed to the input power factor corrected (PFC) rectifier that converts the AC power to DC power for the inverter. In this mode, power shall also be derived from utility power for the battery charger. The inverter shall derive DC power from either the PFC rectifier or the battery and regenerate filtered and regulated AC sinewave power for the connected load. The battery shall be charged once the unit is connected to utility power, regardless of whether the UPS is ON or OFF. In the event of a utility outage or severe abnormality (sag or swell), the inverter shall support the connected load from battery power until the battery is discharged or the utility returns, whichever occurs first.
.2 Battery: Upon failure of utility / mains AC power, the critical AC load shall be supplied by the inverter, which obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility / mains AC source.
.3 Recharge: Upon restoration of utility / mains AC power, after a utility / mains AC power outage, the input converter shall automatically restart and assume supplying power to the inverter and the battery charger to recharge the battery.
.4 Automatic Restart: Upon restoration of utility / mains AC power, after a utility / mains AC power outage and complete battery discharge, the UPS shall automatically restart and assume supplying power to the critical load and the battery charger automatically recharges the battery. This feature shall be

capable of being disabled by the user.
.5 Bypass: The integral bypass shall perform an automatic transfer of the critical AC load from the inverter to the bypass source, in the event of an overload, PFC failure, overtemperature, DC bus overvoltage or inverter failure conditions.

1.5 DESIGN REQUIREMENTS

.1 Voltage
.1 Input: 120 Vac nominal: 0-140 Vac, 60 Hz, single-phase, 2-wire plus ground.
.2 Output: 120 Vac nominal: 120 Vac ±3 %, 60, single-phase, 2-wire plus ground.
.2 Output Load Capacity: 1500 VA / 1300 Watts at 0.9 lagging power factor
.3 Internal Battery: Valve-regulated, non-spillable, flame—retardant lead acid cells
.4 Reserve Time: 4 minutes at full load with ambient temperature of 25 °C
.5 Battery Recharge: The UPS shall contain a battery recharge rate designed to prolong battery life. Recharge time for UPS internal batteries shall be 3 hours to 90 % capacity after a complete discharge into full load.

1.6 SYSTEM PERFORMANCE

.1 AC Inputs to UPS
.1 Voltage configuration: The UPS shall operate at the following values without drawing power from the batteries:
.1 At 90 % Load
.1 Transfer Voltage: 97 Vac
.2 Comeback Voltage: 104 Vac
.2 At 70 % Load
.1 Transfer Voltage: 78 Vac
.2 Comeback Voltage: 85 Vac
.3 At 30 % Load
.1 Transfer Voltage: 61 Vac
.2 Comeback Voltage: 68 Vac
.2 Frequency: UPS shall auto-sense input frequency when first powered up and shall operate within the following specifications. UPS shall be capable of cold start with default frequency of 60 Hz.
.3 Input Power Factor: Greater than 0.99 lagging at rated load.
.4 Input current reflected distortion: 5 % total harmonic distortion (THD)
.5 Input current: 12 A
.6 Inrush current (initial startup, no load): The UPS shall have a maximum inrush current of 6 times the full load peak input current.
.7 Input line transient immunity: UPS shall conform to an input line transient confirming to ANSI C62.41, Category A, Level 3 test.
.8 Surge protection: MOV ratings shall be 175 V, 80 Joules minimum connected L-N.
.2 AC Outputs, UPS Inverter
.1 Voltage configuration: 120 Vac, 60 Hz, single-phase, 2-wire plus ground.
.2 Voltage regulation: ±3 % steady state.
.3 Frequency regulation: ±5 % synchronized to utility / mains. ±0.1 Hz free running or on battery operation.
.4 Frequency slew rate: 1.0 Hz per second maximum

.5 Voltage distortion: <3 % total harmonic distortion (THD) typical into a 100 % linear load, <5 % THD typical into a 100% non-linear load with a crest factor ration of 3:1.
.6 Load power factor range: The rated load power factor will be 0.9 lag.
.7 Output power rating: 1500 VA / 1350 Watts at 0.9 lagging power factor.
.8 Output overload capability:
.1 105-125 % for 5 minutes
.2 125-150 % for 1 minute
.3 150-200 % for 2 seconds
.4 >200 % for 0.25 seconds
.9 Voltage transient response:
.1 ±7 % in line mode 0-100 % loading of the UPS.
.2 ±7 % in battery mode 0-100 % loading of the UPS.
.10 Transient recovery time: To nominal voltage within 90 ms.
.11 Efficiency: ≥ 89% AC to AC, minimum

1.7 ENVIRONMENTAL CONDITIONS

.1 Ambient temperature: The UPS shall be operational with the following maximum power factor degradation at full load:
.1 0 to 25 °C: 100 %
.2 26 to 30 °C: 100-93 %
.3 31 to 35 °C: 92-86 %
.4 36 to 40 °C: 85-79 %
.2 Relative humidity: 0-95 % non-condensing
.3 Audible noise:
.1 <45 dBA maximum at 1 m from front and side
.2 <46 dBA maximum at 1 meter from rear.
.4 Electrostatic discharge: The UPS shall be able to withstand an electrostatic discharge compliant to IEC 61000-4-2.

1.8 SHOP DRAWINGS

.1 Submit shop drawings in accordance with The City of Winnipeg Construction Specifications Section CW1110 – General Instructions.
.2 Include:
.1 Outline sketch showing ratings, dimensions and weights
.2 User manual that shall include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step-by-step operating procedures and general maintenance guidelines.

1.9 WARRANTY

.1 The UPS manufacturer shall warrant the UPS against defects in materials and workmanship for two (2) years. The no-hassle replacement warranty shall include shipping to and from the customer site.

1.10 QUALITY ASSURANCE

.1 The UPS manufacturer shall be ISO 9001:2008 certified.
.2 The UPS manufacturer shall fully and completely test the UPS to ensure compliance with the specification. These tests shall include operational discharge and recharge tests on the internal battery to ensure performance.

1.11 CLOSEOUT SUBMITTALS

.1 Provide data for incorporation into operation and maintenance

manual specified in Section 01 78 00 - Closeout Submittals.
.2 Operation and Maintenance Manual to include:
.1 Technical data:
.1 Approved shop drawings;
.2 Characteristic curves for automatic circuit breakers and protective devices;
.3 Project data;
.4 Technical description of components;
.5 Parts lists with names and addresses of suppliers.

1.12 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS

2.1 FABRICATION

.1 All materials and components making up the UPS shall be new, of current manufacture and shall not have been in prior service except during factory testing. All relays shall be provided with dust covers.
.2 All wiring shall be copper.
.3 Enclosure
.1 The UPS unit shall be composed of the following components housed in a NEMA 1 enclosure and shall meet the requirements of IP20.
.1 Input PFC converter
.2 Battery charger
.3 Input filter
.4 Internal bypass circuit
.5 Batteries
.2 The UPS enclosure shall be cleaned, primed and painted.
.3 The internal battery unit shall be shipped separately and shall be installed during the UPS installation process.
.4 The UPS shall be forced air cooled by an internally mounted, continuous fan. Fan power shall be provided from the internal DC supply. Air intake shall be through the front of the unit and exhausted out the rear of the unit.

2.2 INPUT CONVERTER

.1 Incoming AC power shall be converted to a regulated DC output by the input converter supplying DC power to the inverter.
.2 The input converter shall provide input power factor correction (PFC) and input current distortion reduction.
.3 AC input current limit
.1 The input converter shall be provided with AC input current limiting whereby the maximum input current is limited to 125 % of the full load input current rating.
.4 Input Protection

.1 The UPS shall have built-in protection against undervoltage, overcurrent and overvoltage conditions including low-energy lighting surges introduced on the primary AC mains.
.2 The UPS shall be able to sustain input surges without damage per criteria listed in ANSI C62.41, Category A, Level 3
.3 The UPS shall have circuit breakers

.5 Battery Recharge
.1 The UPS shall contain a battery recharge rate designed to prolong battery life.
.2 The battery shall be constant current charged to restore capacity, then shall be constant voltage charged to maintain the battery in a fully charged state.
.3 Recharge time for the internal UPS batteries shall be three (3) hours maximum to 90 % capacity (full load discharge rate).
.4 The UP shall contain DC overvoltage protection so that if a DC voltage exceeds the pre-set limit, the UPS will shut down automatically and the critical load will be transferred to bypass.

2.3 INVERTER

.1 The UPS inverter shall be a pulse-width-modulated (PWM) design capable of providing the specified AC output.
.2 The inverter shall convert DC power from the input converter output or the battery into precise sinewave AC power for supporting the critical AC load.
.3 Overload
.1 The inverter shall be capable of supplying current and voltage for overloads exceeding 100 % and up to 200 % of full load current.
.2 A visual indicator and audible alarm shall indicate overload operation
.3 For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components.
.4 The inverter shall be self-protecting against any magnitude of connected output overload.
.5 The inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective devices.
.4 Inverter DC Protection
.1 The inverter shall be protected by the following DC shutdown levels:
.1 DC Overvoltage Shutdown
.2 DC Undervoltage Shutdown (End of Discharge)
.3 DC Undervoltage Warning (Low Battery Reserve)
.5 The inverter shall hold the output frequency to ±0.1 Hz of nominal when not synchronized to the utility / mains source.
.6 Output Protection: The UPS inverter shall employ electronic current limiting circuitry.
.7 To prevent battery damage from overdischarging, the UPS control logic shall automatically raise the shutdown voltage setpoint; depending on output load at the onset of battery operation.

2.4 DISPLAY AND CONTROLS

.1 The UPS shall be provided with a microprocessor-based unit status display and controls section designed for convenient and reliable user operation.
.2 The monitoring functions such as status and alarm indicators shall be displayed on an LED display.
.3 The UPS shall contain the following indicator lights:
.1 Fault Indicator – Shall illuminate red if the UPS has

detected a fault and shall be off if there is no fault.
.2 AC Input Indicator – Shall illuminate green when the utility input power is normal; shall be off during utility failure; shall flash when a L-N reversal occurs in the AC input power supply or when there is a loss of proper grounding for the UPS.
.3 Battery Indicator – Shall illuminate amber when the battery is supplying power; shall be off when the battery is not supplying power.
.4 Inverter Indicator – Shall illuminate green when the inverter is supply power; shall be off when the inverter is not supplying power.
.5 Bypass Indicator – Shall illuminate amber when the bypass is supplying power; shall be off when the bypass is not supply power; shall flash when utility power is outside specification.

.4 Controls
.1 The UPS startup and shutdown operation shall be accomplished by the ON and OFF push buttons on the front panel of the UPS.
.2 The ON push button shall be a means to turn the UPS on and also manually test the battery and reset active visual and audible alarms.
.3 Pressing the OFF push button once shall allow manual transfer of the load from the inverter to bypass power.
.4 Pressing the OFF push button twice within four-second time period when the UPS is in bypass mode shall completely shut down the UPS and its connected load in normal and battery mode.

2.5 ON-LINE BATTERY TEST

.1 The UPS shall feature an automatic battery test with the factory default test interval set at every 2 weeks.
.2 The battery test shall ensure the capability of the battery to supply power to the inverter while loaded.
.3 If the battery test fails, the UPS shall display a warning message to indicate the internal batteries need replaced.
.4 The battery test feature shall be user accessible by the push button on the front of the unit and with communication software.
.5 The automatic battery test feature shall be capable of being disabled or configured to operate every 7, 14, 21 or 28 days through user configuration program.

2.6 BYPASS

.1 A bypass circuit shall be provided as an integral part of the UPS
.2 The bypass control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals and operating alarm conditions
.3 The control circuit shall provide a transfer of the load to the bypass source if available and if the inverter is capable of powering the load (i.e. if there is an overload condition, if the unit is in manual bypass mode or if the voltage or frequency is out of tolerance).
.4 The transfer control logic shall activate the bypass automatically, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:
.1 UPS overvoltage
.2 UPS overtemperature
.3 PFC failure
.4 Inverter failure
.5 DC bus overvoltage
.5 Once the overload condition is reduced the load shall be automatically transferred back to inverter power.

2.7 INTERNAL BATTERY

.1 Valve-regulated, non-spillable, flame-retardant lead acid cells shall be used as a stored-energy source for the UPS.
.2 The battery shall be housed internal to the UPS cabinet and sized to support the inverter at rated load and power factor, with ambient temperature of 25 °C for a minimum of 7 minutes reserve time.
.3 The expected life of the battery shall be 3-5 years or a minimum of 250 complete discharge cycles.
.4 The UPS units shall have the capability to allow the operator to replace the internal battery.

2.8 OUTPUT DISTRIBUTION

.1 Output distribution shall be integral to the UPS and located on the rear of the unit with six (6) NEMA 5-15R receptacles.

2.9 COMMUNICATIONS

.1 The UPS shall provide a contact closure for remote monitoring of alarm conditions in the UPS delivering signals for:
  .1 On Battery
  .2 On Bypass
  .3 Low Battery
  .4 Summary Alarm
  .5 UPS Fault
  .6 On UPS
.2 The alarm contact shall be rated for 24 Vdc at 1 A.

2.10 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 00 10 - Common Work Results - Electrical.

2.11 ACCEPTABLE PRODUCT

.1 Liebert GXT3 On-Line UPS 1500VA or approved equal in accordance with B6.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Connect ac mains to main input terminal.
.2 Connect UPS output to load.
.3 Start-up UPS and make preliminary tests to ensure satisfactory performance.

END OF SECTION