Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 26 33 16 - Battery Racks.

1.2 REFERENCES

.1 CSA International.

.1 CAN/CSA-C813.1-01(R2006), Performance Test Method for Uninterruptible Power Supplies.

.2 American National Standards Institute (ANSI).

.1 ANSI S1.13, Measurement of Sound Pressure Levels in Air.

.2 ANSI S1.4 with Amd. S1.4A, Specification for Sound Level Meters.

.3 Underwriters Laboratories (norm UL 1778), ULC certification.

.1 IEC, Semiconductor Converter Standards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: include information as follows:

.1 Catalogue information.

.2 Shipping weight.

.3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.

.4 Description of system operation, referenced to schematic diagram, for:

.1 Manual control during initial start-up and load transfer to bypass and back to inverter output.

.2 Inverter.

.3 Bypass.

.5 Estimate with supporting data for Mean Time to Repair factor (MTTR).

.6 Full load kVA output at 0.9% lagging power factor.

.7 Efficiency of system at 25%, 50%, 75% and 100% rated load.

.8 Type of ventilation: natural or forced.

.9 Battery:

.1 Number of batteries.

.2 Maximum and minimum voltages.

.3 Type of battery.

.4 Type of plates.

.5 Catalogue data with battery trade name and type.

.6 Size and weight of each battery.

.7 Battery charge and discharge curves of voltage, current, time and capacity.

.8 Derating factor for specified temperature range.

.9 Nominal ampere hour capacity of each battery.

.10 Maximum short circuit current.

.11 Maximum charging current expected for fully discharged condition.

.12 Recommended low voltage limit for fully discharged condition.

.13 Expected life.

.10 Inverter:

.1 Type and catalogue number.

.2 DC current at minimum battery voltage to produce full load AC output.

.11 Rectifier:

.1 Type and capacity, with catalogue number.

.2 Battery charging sequence.

.3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices.

.4 Guaranteed noise level.

.5 Estimated life.

.6 Metering.

.7 Alarms.

.12 Manufacturer's field experience with UPS of similar ratings including engineering expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.

.13 Evaluation of Canadian content.

.14 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.

.15 Cooling air required in m^3/s.

.16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

.17 Typical operation and maintenance manual.

.18 Description of factory test facilities.

.19 Manufacturer's maintenance capabilities including:

.1 Willingness to undertake maintenance contract.

.2 Number of trained personnel available.

.3 Location of trained personnel and repair facilities.

.20 Manufacturer's written installation recommendations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.

.2 Include outline schematics showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement, and dimensions.

1.4 PROTECTION OF SYSTEMS

.1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.

.2 Automatic circuit breakers and protection included in:

.1 AC input to rectifier.

.2 Battery input.

.3 Bypass circuit input.

.4 Inverter output.

.3 Surge suppressors:

.1 To protect system against supply voltage switching transients.

.2 To protect internal circuits where necessary against voltage transients.

.4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.

.5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.

.6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for uninterruptible power systems static (UPS) for incorporation into manual.

.3 Operation and Maintenance Manual to include:

.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.

.2 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 Part lists with names and addresses of suppliers.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements: Crating:

.1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.

.2 For rail or sea shipment use double layer of vapour barrier and 19 mm plywood covering.

.3 Subassemblies may be packed separately.

.4 Label crates:

.1 Shipping address.

.2 Weight and dimensions.

.3 Serial number of unit and brief description of contents.

.4 Stencilled with durable paint on at least two sides of each crate.

.5 List of contents:

.1 In weatherproof envelope stapled on outside of each crate.

.2 Copy placed inside each crate.

.6 Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.7 WARRANTY

.1 For the Work of this Section 26 33 53 - Uninterruptible Power Systems Static, 12 months warranty period is extended to 60 months.

.2 Contractor hereby warrants battery against defects in material and workmanship for 10 years. This warranty is for 100% replacement for first five years and prorated in equal yearly decreasing increments for remaining 5 years until expiration of warranty at end of 10 years from date of Certificate of Substantial Performance.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 4 sets of each type and size of fuses used.

.2 4 sets indicating lamps.

1.9 ACCEPTABLE PRODUCTS AND MATERIALS

.1 Where a particular brand name is stipulated, see Instructions to Bidders for procedure for requesting approval of substitute materials and products.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Uninterruptible power supply system, 40 kW, N+1 redundant, modular construction and scalable 3x10 kW + 10 kW.

.1 Provision for future addition of a 10 kW unit for ultimate capacity of 4x10 kW + 10 kW.

.2 Each module to consist of:

.1 Input/Output Cubicle.

.2 Rectifier/Invertor Cubicle.

.3 Bypass/Isolate Switch Cubicle.

.4 Controls and meters.

.3 Ensure system uses normal power supply mains and battery to provide continuous, regulated AC power to isolated load.

.4 Equipment: capable of operating continuously and unattended.

.5 Ensure that Uninterruptible Power Systems (UPS) is compatible with equipment that it feeds and with source from which it is fed.

2.2 PERFORMANCE

.1 Normal operation:

.1 System operates on mains power when mains voltage is within ±10% of nominal value and mains frequency is between 59.5 and 60.5 Hz.

.2 System performance and reliability:

.1 Consider any deviation from the required output power waveform as failure in UPS.

.2 Submit estimate, with supporting calculations, of Mean Time Between Failures (MTBF) expressed in hours.

.2 Battery operation:

.1 System transfers automatically to battery operation.

.1 When manually selected at control panel.

.2 When mains power fails.

.3 When mains voltage varies more than 10% from nominal or mains frequency varies more than 0.5 Hz from 60 Hz.

.4 When mains power is restored and mains voltage is within 10% of nominal and mains frequency is within 0.3 Hz of 60 Hz, system automatically resynchronizes with mains;

.5 Slew rate of frequency during transition period of system output automatically synchronizing with mains and return to its internal frequency to be set between 0.5 to 1.0 Hz per second.

.3 Internal Static Bypass operation:

.1 Ensure system can be bypassed for maintenance purposes, automatically by manual selection at control panel to connect load directly to AC mains. Transfer without load interruption and leaving inverter energized.

.2 Load transfer from mains back to system automatically by manual selection at control panel when maintenance completed.

.3 Automatic transfer of load to mains in not more than 1/4 cycle including sensing with inverter left energized but disconnected from load in case of:

.1 Inverter overloaded.

.2 Short circuit in load.

.4 Automatic retransfer of load to system without load interruption when above conditions disappear.

.5 Automatic transfer of load to mains in not more than 1/4 cycle including sensing and shutdown of inverter in case of inverter internal malfunctions.

.6 Automatic transfer of load to mains without load interruption and inverter shutdown in case of:

.1 Over temperature harmful to system.

.2 Loss of forced ventilation.

.3 Low voltage of DC supply to inverter.

.7 Bypass capable of closing onto and withstanding momentary fault current of 800% of rating for 0.01 s.

2.3 UNINTERRUPTIBLE POWER SYSTEM

.1 Input Power:

.1 Three phase, 208 V, 3-wire, 60 Hz.

.2 Normal supply from AC mains.

.3 Emergency supply from standby automatic diesel-electric unit.

.2 Output Power:

.1 Three phase, 120/208 V, 4 wire, grounded neutral, 60 Hz.

.2 Full load output for each module: 10 kW.

.3 Overload capability: 125% of rated full load current at rated voltage for 10 minutes.

.4 Frequency - nominal 60 Hz:

.1 Adjustable from 58.5 to 61.5 Hz.

.2 Maximum variation from set value under load changes, including transients, 0.3 Hz maximum.

.3 Drift from set value - after two months normal operation within ambient temperature range of 0° to 40°C, not to exceed 0.6 Hz.

.5 Duration of full load output after mains failure not less than 15 minutes

.6 Output voltage control:

.1 Continuously adjustable on load at least 5% from rated value.

.2 Voltage regulation: voltage not to change by more than 2% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.

.3 Transient voltage change not to exceed ±10% of rated voltage upon 50% sudden load change, loss or return of AC input voltage to system when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.

.4 Harmonics over entire load range:

.1 Total RMS value not to exceed 5% RMS value of total output voltage.

.2 Single harmonic not to exceed 3% of total output voltage.

.5 Proper angular phase relation maintained within 4 electrical degrees at up to 20% load unbalance.

.7 Efficiency: Overall system efficiency at rated load with battery fully charged not less than 75%.

.8 Interference suppression:

.1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.

.2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

2.4 ELECTRICAL REQUIREMENTS

.1 In accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Bring out test points to protected coded pin jacks at convenient locations to permit testing without hazard, including:

.1 Inverter output ahead of output switch, 3 phase and neutral.

.2 Mains power 3 phase and neutral.

.3 Voltage across each SCR.

.4 Points requiring monitoring for on-site alignment, for determination of faulty sub-assemblies or printed circuit cards, including indication of oscillator pulse and operation of voltage control.

.3 No battery other than main battery incorporated in design.

.4 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.5 Variable resistors: fine adjustment, rheostat type.

.6 Phasing marked on input and output terminals, viewed from front of equipment:

.1 Left to right.

.2 Top to bottom.

.3 Front to back.

.7 Indicator lamps: long life incandescent or neon, rated for continuous duty, with sockets having adequate heat dissipation of lamps and dropping resistor if used.

.8 Solid state circuits used where more reliable than mechanical timers or control relays.

.9 Standard components available from commercial sources used throughout, with 10 years minimum shelf life.

.10 Arrangement to permit easy removal of defective components to facilitate servicing, by replacing with stock spares.

.11 Small components, related to specific function, removable plug-in modular sub-assembly or printed circuit card.

.12 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

.13 Components and sub-assemblies accurately made for interchangeability.

2.5 ENCLOSURE

.1 Dead front free standing sheet steel 2.5 mm minimum thick, CSA Enclosure 1.

.2 Access from front only, or from front and rear.

.3 Meters, indicating lamps and controls group mounted in panel front.

.4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping.

.1 Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys.

.2 Hinges to permit doors to be lifted off cubicle.

.5 Cubicle Height: 1.8 m maximum.

.6 External cable connections at top of cubicle through bolted plate for drilling at site to suit.

.7 Ambient temperature range during operation -20°C to +40°C. Natural or forced ventilation as required.

.1 For forced ventilation power from inverter output and fan directly driven by single phase motor mounted on vibration isolators.

.2 Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

.8 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.9 Maximum operating sound level not to exceed 80 dB (A) as measured on sound level meter with A weighting and slow response, at distance of 1.8 m.

.10 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

2.6 RECTIFIER

.1 Input power supply from:

.1 AC mains.

.2 Automatic diesel engine driven generating unit.

.2 Input disconnect: bolt-on moulded case three pole circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

.3 Surge Suppressor: to protect equipment from supply voltage switching transients.

.4 Rectifier:

.1 Silicon controlled rectifier assembly or sealed silicon diodes.

.5 Filter: for rectifier DC output.

.6 Fuse: to protect DC output.

.7 Meters:

.1 DC voltmeter, switchboard type, accuracy ±2% of full scale, to measure rectifier output voltage.

.2 DC ammeter, switchboard type, accuracy ±2% of full scale, to measure rectifier output current.

.8 Adjustments and Controls:

.1 Line voltage adjusting taps to allow for ±10% variation from nominal.

.2 Manual adjustment of float voltage with range of ±5%.

.3 Manual adjustment of equalizing voltage.

.4 Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.

.5 Provision to disconnect rectifier from inverter and battery if rectifier dc output exceeds safe voltage limits of battery.

.9 Metres, adjustments, and controls to be grouped on front panel.

.10 Performance of rectifier:

.1 Automatically maintain battery in fully charged state while mains power available, and maintain DC float voltage within ±1% of setting, no load to full load, during mains voltage variations up to ±10%.

.2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.

.3 Automatic equalize charging circuit to initiate equalize charging of battery for 24 hours after discharge of 5% of ampere hour battery rating.

.4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours to return unit to float charge.

2.7 INVERTER

.1 Input power supply from:

.1 Rectifier DC output.

.2 Battery DC output.

.2 Input Disconnect: bolt-on moulded case, single pole, circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40°C ambient, magnetic instantaneous trip element.

.3 Input Filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

.4 Power Stage: high frequency switching type, dual cooled disc type silicon controlled rectifier (SCR). Components, solid state devices capable of satisfactory operation under ambient conditions of -35 C to +55 C.

.5 Logic Module:

.1 Integrated circuit logic.

.2 Silicon semiconductors.

.3 Plug-in modules.

.4 Gold plated plug-in connector.

.5 Front accessible field adjustments for voltage and frequency.

.6 Front accessible test points: suitably protected coded pin jacks.

.7 Frequency reference module.

.8 Current limiting module, automatic high speed by controlled reduction of output voltage.

.9 Voltage regulator.

.6 Output Filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

.7 Digital meters:

.1 Voltmeter a.c.

.2 Ammeter a.c.

.3 Wattmeter.

.4 Frequency meter.

.8 Output disconnect: bolt-on, moulded case, three pole circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 °C, magnetic instantaneous trip element.

.9 Meters and controls: grouped on front panel.

2.8 BATTERY

.1 Battery Cabinet: in accordance with Section 26 33 16 - Battery Racks.

.2 Battery type and electrical characteristics: in accordance with Section 26 33 16 - Battery Racks.

.1 Discharge current to supply inverter at full load output, for 10 minutes.

2.9 STATIC BYPASS SWITCH

.1 Two solid state closed circuit automatic transfer switches.

.2 Logic unit with three normal source voltage sensors, which monitor overvoltage undervoltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:

.1 Normal source voltage lost: transfer time and sensing 1/4 cycle;

.2 Normal source: undervoltage at 80% of nominal value; adjustable.

.3 Normal source: over voltage at 110% of nominal value.

.4 Loss of normal source static switch continuity.

.5 Short-circuit on normal source trips normal source breaker.

.4 Return to Normal Source:

.1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:

.1 Manual bypass switch for maintenance and testing without load disturbance.

.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.

.3 Alternate power source loss alarm contacts.

2.10 OPERATING DEVICES

.1 Operating Accessories:

.1 Counter for number of failures of normal mains AC power: non-reset type, zero to 99,999 operations.

.2 Elapsed time meter indicating accumulated time of battery discharge in minutes non-reset type, zero to 99,999.9 minutes.

.3 Elapsed time meter indicating accumulated time of inverter operation in hours, non-reset type, zero to 99,999.9 hours.

.2 Mode lights mounted on front panel to indicate:

.1 AC output on inverter - green.

.2 AC input available - green.

.3 Inverter and AC input synchronized - green.

.4 Inverter and AC input not synchronized - amber.

.5 Static bypass switch in bypass position - red.

.6 Overtemperature alarms:

.1 Rectifier - red.

.2 Inverter - red.

.3 Bypass switch - red.

.7 Cooling fan fuse open - red.

.8 Inverter output over voltage - red.

.9 Inverter output under voltage - red.

.10 Battery over voltage - red.

.11 Battery under voltage - red.

.12 Inverter fuse/breaker open - red.

.13 Rectifier fuse/breaker open - red.

.14 Static bypass switch fuse/breaker open - red.

.15 UPS on battery operation - red.

.16 Rectifier in equalize mode - amber.

.17 Battery discharging indicator - red, to change from steady to flashing during final 5 to 10 min of battery duration.

.3 Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.

.4 Remote annunciator panel and alarms:

.1 1 cabinet for remote points including:

.1 Normal operating mode - green.

.2 UPS operating from battery - red.

.3 Bypass switch in operation - red.

.2 Single stroke gong to sound when any mode light at main UPS panel shows red.

.3 Power for remote lights and alarm from UPS output.

2.11 FABRICATION

.1 Shop Assembly:

.1 Rectifier unit.

.2 Inverter unit.

.3 Bypass switch unit.

.4 Battery cabinet and battery.

.2 Interconnect units, and add remote mode lights, alarms and controls to produce complete uninterruptible power system before requesting Departmental Representative to witness factory tests.

2.12 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Cubicles:

.1 Inside finish: white.

.2 Exterior finish: manufacturers standard colour.

.3 Exterior hardware and trim: corrosion resistant and not requiring painting such as stainless steel or aluminum.

2.13 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 For major components such as AC input breaker, inverter breakers, bypass switch: size 4 nameplates.

.3 For mode lights, alarms, meters: size 2 nameplates.

2.14 SOURCE QUALITY CONTROL

.1 Complete system including rectifier, inverter, bypass switch, remote annunciator panel, controls and battery factory tested in presence of Departmental Representative.

.2 Notify Departmental Representative:

.1 One week in advance of date of factory test.

.2 That system has had preliminary testing and has met design requirements satisfactorily.

.3 Test Procedures:

.1 Prepare blank forms and check sheet with spaces for recording data.

.2 Mark check sheet and record test data on forms in duplicate as test proceeds. Attach meter recordings.

.3 Deliver duplicate of test results to Departmental Representative at end of test.

.4 Include information from original test as part of Operations and Maintenance Manual.

.4 Test Equipment:

.1 Instruments used during test, including indicating meters installed as part of system to have recent calibration certificate.

.2 Dummy load for testing, adjustable to 150% of system rated output. Load on each phase adjustable from zero to 100% so that unbalanced output maybe tested for 3 phase systems.

.5 Tests:

.1 Visual inspection to determine:

.1 Materials, workmanship, and assembly conform with design requirements.

.2 Parts are new and free of defects.

.3 Battery and components are not damaged.

.4 Battery cells are of identical construction.

.5 Electrolyte in each cell is at manufacturer's recommended full level.

.6 Each battery cell polarity and polarity of connections to inverter are correct.

.7 Proper size fuses are installed.

.8 Metres have suitable range.

.9 Accessories are present.

.10 Portable metres for acceptance tests are suitable and instrument transformers connected correctly.

.2 Demonstrate:

.1 System start-up and shut down.

.2 Operation during mains power failure, recording output during failure and return of mains power, using oscilloscope and camera attachment. Repeat several times.

.3 Adjustable settings.

.4 Record values measured at test points using oscilloscope, digital multimetre, visicorder and camera attachment.

.5 Protective devices and indications function as designed. Record actual settings, and note operation of remote indications and transfer to bypass. Tests to include:

.1 Annunciator lights correct indication.

.2 Overcurrent on inverter output.

.3 Over voltage and under voltage of inverter output.

.4 DC input voltage to inverter too low. Gradually reduce DC input voltage to inverter while delivering full load output and load to transfer automatically to bypass and inverter shut down. Record input and output values.

.6 Simulate over temperature by applying heat to sensor with hot air blower.

.7 Simulate fuse blowing to test indication response.

.8 Simulate fan failure.

.9 Bypass switch automatic operations. Record with camera/oscilloscope absence of load disturbance during automatic bypass switching.

.10 Over voltage of rectifier DC output.

.3 Harmonic test:

.1 With system fully loaded, one-half loaded, and at no load, determine total harmonic content with harmonic distortion meter at output terminals.

.2 Determine each harmonic magnitude with harmonic wave analyzer.

.3 Measure phase to neutral at 0.8 lagging power factor.

.4 Transients:

.1 With normal power input, apply full load to system.

.2 Remove one half load from each phase.

.3 Reapply one half load instantly.

.4 Record voltages and currents using visicorder.

.5 Steady load:

.1 Switch system onto AC mains, start inverter and connect dummy load.

.2 Operate system at full rated load for 24 hours and at 125% load for 10 minutes in ambient temperature of 40°C.

.3 Record data at start of test and at half hour intervals thereafter; including:

.1 Input frequency.

.2 Input voltage each phase.

.3 Input current each phase.

.4 Input kW.

.5 Output voltage phase to phase, phase to neutral.

.6 Output current each phase.

.7 Output kW.

.8 Temperature of ventilating air-in.

.9 Temperature of ventilating air-out.

.10 Temperature at critical zones.

.11 DC voltage to inverter.

.12 DC current to inverter.

.13 Rectifier DC current.

.6 Varying loads:

.1 Take one set of readings as above of no load, 25% load, 50% load, 75% load and 125% load.

.2 Calculate efficiencies of rectifier, inverter, and complete system.

.7 Unbalanced loads:

.1 Adjust loads on inverter to full load on two phases, 80% load on third phase.

.2 Adjust loads on inverter to zero load on two phases, 20% load on third phase.

.3 For both cases, record phase and line voltages and currents with phase angles to prove that phase relation remains unchanged with unbalanced loads.

.8 Battery:

.1 Charge battery to ensure cells fully charged. When voltage reaches steady value at end of charge, record:

.1 Ambient temperature.

.2 Temperature of each cell.

.3 Voltage of each cell.

.4 Voltage of battery.

.5 Charging current.

.6 Specific gravity of each cell (lead acid battery only).

.2 Discharge battery by operating uninterruptible power system with AC mains open, at full rated output for duration quoted in design requirements. Record, at 5 minutes intervals:

.1 Voltage of battery.

.2 Current.

.3 Voltage of 10% random cells.

.4 Ambient temperature.

.5 Battery temperature.

.6 Specific gravity of 10% random cells (lead acid only).

.3 Recharge battery automatically by closing AC mains supply to system for 4 hours period, with dummy load connected. Record at 15 minutes intervals.

.1 Battery voltage.

.2 Charging current.

.4 At start and finish of charge record ambient and battery temperatures, and specific gravity of each cell (lead acid only).

.5 Repeat discharge test and readings to prove battery was at least 95% recharged in 4 hours charge period.

.6 Recharge battery.

.9 Operating sound level:

.1 Operator to take reading by placing meter in front of him with microphone pointed at right angles to path of travel of generated sound, positioned at height of 1.5 m and distance of 1 m from equipment to be tested.

.2 Measure sound level during low ambient sound level.

2.15 ACCEPTABLE PRODUCTS

.1 Model Symmetra PX 3x10 kW + 10 kW of APC (Schneider Electric).

.2 APM Series of Liebert.

.3 Replacement materials or products: approved by addendum according to Instructions to bidders.

2.16 UNINTERRUPTED POWER SUPPLY UNIT FOR WORKSTATION

.1 Capacity: 900 W / 1,500 VA.

.2 Output Voltage: 120 V.

.3 Output Frequency (sync to mains) 50 / 60 Hz ±3 Hz.

.4 Topology: Online interactive.

.5 Output Connections:

.1 (5) NEMA 5-15R (battery backed) NEMA 5-15R.

.2 (5) NEMA 5-15R (Protection against overvoltage) NEMA 5-15R.

.6 Input:

.1 Rated input voltage: 120 V Input Frequency 50/60 Hz ±3 Hz (auto sensing).

.2 Input connections: NEMA 5-15P.

.3 Cord length 1.83 m.

.7 Batteries:

.1 Maintenance free battery type, sealed lead acid electrolyte with tight suspension.

.2 Charging time: 8 hours.

.8 Acceptable Products:

.1 Model BR1500G APC (Schneider Electric).

.2 Model PSA 1500MT3-120U of Liebert.

.3 Replacement materials or products: approved by addendum according to Instructions to bidders.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for uninterruptible power systems static (UPS) installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Locate UPS cubicles, battery rack and battery as indicated.

.2 Locate and install remote mode lights and alarm cabinets as indicated.

.3 Assemble and interconnect components to provide complete UPS as specified.

.4 Connect AC mains to main input terminal.

.5 Connect UPS output to load.

.6 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.3 TESTING

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and to CAN/CSA-C813.1.

.2 Provide:

- .1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
- .2 Dummy load adjustable to 150% of system rated output.

.3 Notify Departmental Representative 10 working days in advance of test date.

.4 Tests:

- .1 Inspection of cubicles, battery rack and battery.
- .2 Inspection of electrical connections.
- .3 Inspection of installation of remote mode lights and alarms.
- .4 Demonstration of system start-up and shut-down.
- .5 Run UPS for minimum period of 4 hours at full rated load to demonstrate proper operation with AC mains input, emergency generator input, no AC input.
- .6 Discharge battery by operating UPS with AC mains open for specified duration of full load. Record readings of temperature of each cell.
- .7 Recharge battery automatically with full rated load on UPS for 4 hours and record readings of voltage of each cell.

3.4 START-UP

.1 Arrange with Departmental Representative:

.1 For factory service engineer to supervise start-up of system, checking, adjusting and testing on site.

.2 For instruction of operation and maintenance personnel on theory, construction, installation, operation and maintenance of system.

.1 Advise on:

.1 Expected failure rate of equipment.

.2 Type of expected failures.

.3 Estimated time between major overhauls based on 20 year equipment life.

.4 Estimated cost of major overhaul based on current costs and excluding travelling expenses.

.5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

.2 Training to be 4 hours minimum.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by UPS installation.

END OF SECTION