

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American National Standards Institute (ANSI)
 - .1 ANSI S1.13-1995(R2010), Measurement of Sound Pressure Levels in Air.
 - .2 ANSI S1.4-1983(R2006)/ANSI S1.4A-1985 (R2006), Specification for Sound Level Meters.
 - .2 Canadian Standards Association (CSA International)
 - .1 CSA C813.1-01 (R2006), Performance Test Method for Uninterruptible Power Supplies.
 - .2 CAN3-Z299.3-85(R2006), Quality Assurance Program - Category 3.
- 1.2 DESCRIPTION
- .1 System to consist of:
 - .1 Rectifier;
 - .2 Invertor;
 - .3 Battery
 - .4 Internal Bypass switch;
 - .5 Controls and meters;
 - .6 External Maintenance Bypass switch in separate cabinet.
 - .2 System to use normal power supply mains and battery to provide continuous, regulated ac power to isolated load.
 - .3 Equipment to operate continuously and unattended.
 - .4 Ensure that Uninterruptible Power Systems (UPS) is compatible with equipment that it feeds.
- 1.3 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 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;
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- 1.3 PERFORMANCE (Cont'd)
- .2 Battery operation:(Cont'd)
- .1 (Cont'd)
- .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 Bypass operation:
- .1 For maintenance purposes, system can be bypassed 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.
- 1.4 PROTECTION
- .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.
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- 1.4 PROTECTION (Cont'd)
- .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 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Include:
 - .1 Outline sketch showing arrangement of cubicles, meters, controls, battery rack, battery arrangement and dimensions.
 - .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 System performance and reliability:
 - .1 Consider any deviation from the required output power waveform as failure in UPS and include estimate, with supporting calculations, of the Mean Time Between Failures (MTBF) expressed in hours.
 - .2 Provide estimate with supporting data for Mean Time to Repair factor (MTTR).
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- 1.5 SHOP DRAWINGS .2 Include: (Cont'd)
- (Cont'd)
- .6 Full load kVA output at unity 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 cells;
 - .2 Maximum and minimum voltages;
 - .3 Type of battery;
 - .4 Type of plates;
 - .5 Catalogue data with cell trade name and type;
 - .6 Size and weight of each cell;
 - .7 Cell charge and discharge curves of voltage, current, time and capacity;
 - .8 Derating factor for specified temperature range;
 - .9 Nominal ampere hour capacity of each cell;
 - .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 m³/s.
 - .16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.
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- 1.5 SHOP DRAWINGS (Cont'd) .2 Include: (Cont'd)
- .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.
- 1.6 QUALITY ASSURANCE .1 Submit for approval to Departmental Representative, indicating and recording instruments calibration certificates, including meters installed as part of system, in accordance with Section 01 33 00.
- 1.7 CLOSEOUT SUBMITTALS .1 Provide data for incorporation into operation and maintenance manual specified in Section 01 78 00.
- .2 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual approved by Departmental Representative. Submit interim copies to Departmental Representative prior to notification of factory test date.
- .3 Operation and Maintenance Manual to include:
 - .1 Operation and maintenance instructions for all equipment and accessories to permit effective operation, maintenance, and repair.
 - .2 As-built schematic wiring diagram of all electrical power and controls. Drawings shall indicate actual set-point of all variable controls, timers and protective devices.
 - .3 Flow diagrams for cooling air systems.
 - .4 Bill of materials showing all major components utilized in manufacture of UPS and related equipment, complete with name, description, and model numbers of original component manufacturer. Data shall be sufficiently complete to permit proper ordering of spare parts. Where required, data shall include serial numbers if pertinent to ordering replacement parts.
 - .5 Certified copy of factory test results.
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- 1.7 CLOSEOUT SUBMITTALS (Cont'd) .3 (Cont'd)
- .6 Space to insert copy of field commissioning records and acceptance test results.
 - .7 Certified copy of warranty.
- 1.8 SOURCE QUALITY CONTROL .1 Provide UPS system which is manufactured and tested under a manufacturer's Quality Assurance Program which complies with the intent of CSA CAN3-Z299.3. Provide a copy of the manufacturer's Quality Assurance Procedures Manual upon request.
- .2 Provide adjustable reactive type load bank and related controls to facilitate factory testing at load up to 150% rated output at 0.8 pf. Load bank to have adjustment increments of nominal 25% of UPS rating, with reactive load adjustment range of 0.75 to 0.9 pf at any kW load.
 - .3 Provide all necessary instrumentation and recording devices to effect the tests.
 - .4 Prepare factory test record sheets with space to record data. Provide copy of proposed test records to Departmental Representative 7 days after tests. Test records shall indicate:
 - .1 Date.
 - .2 UPS: Make, Model, Serial Number.
 - .3 UPS rated output voltage (V) and current (A) at 100%, 125%, and 150% rated load. Indicate rated duration of overload conditions.
 - .4 UPS rated input voltage (V), current (A) at output loads under conditions of maximum recharge and normal float charge.
 - .5 Rated input current distortion at specific harmonics and THD under conditions of 50% and 100% rated load, normal float charge.
 - .6 Check lists and forms for logging of all required tests and records as specified herein. Where specifications indicate test and record, include appropriate provisions on the test record sheets. Where instrument recordings are taken, the recording charts shall be identified and cross-referenced to the test record sheets.
 - .5 Maintain working records as tests proceed. Neatly transfer actual test results to clean copy for test record submissions and manuals. Provide Departmental Representative with copy of working records and final test records.
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- 1.8 SOURCE QUALITY CONTROL
(Cont'd)
- .6 Provide test results to Departmental Representative for review and approval prior to shipment. If Departmental Representative's review discloses test/record deficiencies or performance deficiencies, repeat applicable portions or complete tests as directed by Departmental Representative.
- .7 Non-running tests and checks: Perform and record the following before starting the unit:
- .1 Verify that all quality control checklists have been properly completed. Verify proper connection of UPS and equipment for testing.
 - .2 Verify proper safety grounding of all equipment and test load bank when installed in the test configuration.
 - .3 Verify electrical and mechanical safety guards secure and in place.
 - .4 Adjustments properly made.
 - .5 All normal and special test instrumentation installed and operational.
- .8 Conduct functional and load tests to verify conformance with Specifications, Codes, and performance requirements. Record results including chart recordings where appropriate.
- .9 Submit certified copy of test results to Departmental Representative for review and approval before shipment to site.
- .10 Following factory test, complete all deficiencies and outstanding manufacturing requirements. Clean and prepare equipment for shipment.
- 1.9 DELIVERY, STORAGE AND HANDLING
- .1 Crating:
- .1 Adequately enclosed and protected from weather and shipping damage by use of minimum 12 mm plywood with vapour barrier inside.
 - .2 For tractor, train 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.
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1.9 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)

- .1 Crating: (Cont'd)
 - .5 List of contents:
 - .1 In weatherproof envelope stapled on outside of each crate;
 - .2 Copy placed inside each crate.
- .2 Store all UPS system equipment in an indoor, dry, heated (to 15°C minimum) location until scheduled delivery to site.
- .3 Coordinate site delivery schedule with site contractor. Do not ship until equipment can be off-loaded and immediately placed in its installed location in the completed building.

1.10 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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 as approved by Departmental Representative.
- .5 Divert unused batteries from landfill to local battery recycling facility approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.11 WARRANTY

- .1 Provide a written warranty stating that the UPS equipment and accessories, including batteries, are warranted by the manufacturer against defects in material and workmanship for a period of one year from the date of on-site commissioning and final acceptance for automatic service. Include copy of warranty in Operation Manuals. Warranty shall include 100% on site parts and labour for repair of defects.
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1.11 WARRANTY .1 (Cont'd)

1.12 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 5 personnel on theory, construction, installation, operation and maintenance of system:
 - .1 After installation and during site testing.
- .2 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.

1.13 MAINTENANCE MATERIALS .1 Provide the following maintenance materials for UPS and related equipment supplied:

- .1 One set of air filter elements.
- .2 One spare cooling fan assembly.
- .3 Five of each size or type of fuse utilized in equipment including any fuses installed in individual components.
- .4 Five of each size or type of indicating lamp.
- .5 Battery maintenance tools including:
 - .1 Insulated terminal wrench.
 - .2 Spare inter-battery connector cable.
 - .3 Spare termination cable.
- .2 In addition to the foregoing materials included with the supply, provide a priced list of all components which are recommended to be stocked on-site for emergency repair purposes.

PART 2 - PRODUCTS

2.1
UNINTERRUPTIBLE
POWER SYSTEM

- .1 General:
 - .1 True online, double-conversion topology.
 - .2 Automatic UPS Bypass on overload or UPS failure.
 - .3 Full system self-test diagnostics on power up.
 - .2 Input power: (true on-line)
 - .1 Three phase, 208/120 V, 4 wire, grounded neutral, 60 Hz.
 - .2 Normal supply from ac mains.
 - .3 Voltage range: -20% to +15% without discharging the battery.
 - .4 Current walk-in: 20 seconds to full load rating.
 - .5 Maximum input current: 150% of nominal full load current.
 - .6 Power factor: 0.80 lagging at nominal input voltage (0.9 PF with optional input filter).
 - .3 Output power:
 - .1 Three phase, 120/208 V, 4 wire, grounded neutral, 60 Hz.
 - .2 Full load output at 0.9 power factor lagging 8 kVA.
 - .3 Overload capability: 125% of rated full load current at 0.8 power factor and rated voltage for 10 min.
 - .4 Battery back up time: 60 minutes.
 - .5 Voltage unbalance: ±3% of nominal for 100% unbalance loads.
 - .6 Frequency - nominal 60 Hz:
 - .1 Adjustable from 58.5 to 61.5 Hz.
 - .2 Maximum variation from set value under load changes, including transients, not to exceed 0.3 Hz.
 - .3 Drift from set value - after two months normal operation within ambient temperature range of 0 degrees to 40 degrees C, not to exceed 0.6 Hz.
 - .7 Duration of full load output after mains failure not less than 15 min.
 - .8 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
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2.1
UNINTERRUPTIBLE
POWER SYSTEM
(Cont'd)

- .3 Output power:(Cont'd)
 - .8 Output voltage control:(Cont'd)
 - .2 Voltage regulation:(Cont'd)
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.
 - .9 Efficiency: Overall system efficiency at rated load with battery fully charged not less than 75%.

2.2 ELECTRICAL
REQUIREMENTS

- .1 In accordance with Section 26 05 00.
 - .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 phases and neutral.
 - .2 Mains power 3 phases 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.
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2.2 ELECTRICAL
REQUIREMENTS
(Cont'd)

- .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 LED.
- .8 Solid state circuits.
- .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.

2.3 UPS INPUT
ISOLATION AND
SUPPRESSION

- .1 Provide isolation and, where required by design, voltage matching transformer to provide galvanic isolation and capacitive shielding of the rectifier input from the AC source.

2.4 ENCLOSURE

- .1 Dead front floor mounted sheet steel minimum 2.5 mm thick, CSA Enclosure Type 2, securely bolted to floor.
 - .2 Access preferably from front only, or from front and rear.
 - .3 Meters, indicating lamps and controls group mounted in panel front.
 - .4 External cable connections at rear of unit.
 - .5 Ambient temperature range during operation -20 degrees C to +40 degrees C. Natural or forced
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- 2.4 ENCLOSURE .5 (Cont'd)
(Cont'd)
- .6 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.
- .7 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.
- .8 Enclosure frames interconnected by ground bus with ground lug for connection to ground.
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- 2.5 RECTIFIER .1 Input power supply from:
 .1 AC mains.
- .2 Input disconnect: bolt-on moulded case circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.
- .3 Isolating transformer: connected between AC input and rectifier input
- .4 Surge suppressor: to protect equipment from supply voltage switching transients.
- .5 Rectifier:
 .1 Full wave Silicon controlled rectifier type.
- .6 Filter: for rectifier DC output.
- .7 Fuse: to protect DC output.
- .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.
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2.5 RECTIFIER
(Cont'd)

- .8 Adjustments and controls:(Cont'd)
 - .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.

2.6 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 degrees 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 Inverter shall utilize fast-switching IGBT transistors, pulse width modulation (PWM) and phase vector synchronization (PVS).
 - .5 Logic module:
 - .1 Integrated circuit logic.
 - .2 Plug-in modules.
 - .3 Gold plated plug-in connector.
 - .4 Front accessible field adjustments for voltage and frequency.
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- 2.6 INVERTER (Cont'd)
- .5 Logic module:(Cont'd)
 - .5 Front accessible test points: suitably protected coded pin jacks.
 - .6 Frequency reference module.
 - .7 Current limiting module, automatic high speed by controlled reduction of output voltage.
 - .8 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 Output disconnect: bolt-on, moulded case circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.
 - .8 Metres and controls: grouped on front panel.
- 2.7 UPS BATTERIES
- .1 Provide totally sealed, valve regulated, lead acid battery sized and configured to meet UPS performance requirements.
 - .2 Provide heavy duty plates, intercell connectors, and terminal posts rated for high discharge current UPS service.
 - .3 Fill cells at manufacturer's factory on the basis of electrolyte weight to ensure proper quantity.
 - .4 Provide self-sealing, removable, safety relief valve and flash arrester.
 - .5 Provide solid copper cell posts. Cell terminals shall be rated for the cell's 1 minute discharge rate without overheating damage and with minimal voltage drop.
 - .6 Provide cell containers constructed of high impact polypropylene. Material to be flame retardant and meet UL Standard 94V-0 and 28% limiting oxygen index. Container cover shall be sealed to the container with a leak-free seal.
 - .7 Cell design suited for 2.25 vpc $\pm 1\%$ continuous float charge. Cell design shall not normally require equalize charge, but the cell shall be capable of equalize charging at 2.33 vpc $\pm 1\%$.
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- 2.7 UPS BATTERIES
(Cont'd)
- .8 Provide battery designed and rated for:
 - .1 10-year expected life at continuous float charge at ambient temperatures of 25°C ±10°C.
 - .2 Minimum 100 deep discharge cycles to 80% depth of discharge.
 - .9 Factory test each battery in accordance with IEEE-450 and with manufacturer's Quality Assurance program. Any individual battery shall have a minimum of 90% rated capacity, and the aggregate average of all batteries provided shall have a minimum aggregate average of 98% rated capacity.
- 2.8 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.
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2.8 STATIC BYPASS SWITCH
(Cont'd)

- .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.

2.9 EXTERNAL MAINTENANCE BYPASS SWITCH

- .1 208V 3-phase 4-wire 30A wraparound bypass switch to provide means of isolating UPS for maintenance or replacement without disrupting power to the load.
.2 Thermal magnetic moulded case make-before-break circuit breakers mechanically interlocked to prevent a backflow of current to the inverter.
.3 Separate CSA Type 2 (sprinkler-proof) steel enclosure, ASA 61 gray, securely bolted to the floor adjacent to UPS.

2.10 OPERATING DEVICES

- .1 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.
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- 2.10 OPERATING DEVICES (Cont'd) .2 Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.
- .3 Ethernet connection port (RJ45) for status monitoring.
- 2.11 FABRICATION .1 Shop assemble:
- .1 Rectifier unit;
 - .2 Inverter unit;
 - .3 Bypass switch unit;
 - .4 External maintenance bypass switch cabinet.
- .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.
- 2.13 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.
- .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 FACTORY TESTS .1 Factory assemble all equipment and test in accordance with Part 1 of this Section. If available, the actual project battery/cabinet assembly may be utilized for testing in lieu of a test battery.
- 2.15 SHIPPING AND DELIVERY .1 Prepare UPS and accessories for shipment. Perform all necessary blocking, tie-down, protection, and removal and storage of external extremities for safe loading, transit,
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- 2.15 SHIPPING AND DELIVERY (Cont'd)
- .1 (Cont'd)
unloading, lifting, and setting in place in the indicated UPS room.
 - .2 Store UPS and coordinate shipping method and necessary crating/weather protection with Site Works Contractor as per Part 1 of this Section.
- 2.16 SITE COMMISSIONING AND ACCEPTANCE TESTING
- .1 Provide factory trained UPS technician to commission, test, and train operation/maintenance personnel. Provide test equipment and load bank as necessary to effect the testing.
 - .2 Provide services in three stages as follows:
 - .1 Commissioning tests - nominally concurrent with initial start-up and functional checks. Loads will be limited, and test running is minimal.
 - .2 Acceptance tests: following completion of other site-related work and prior to final acceptance of overall project work. Tests will include complete system functional tests plus a 4-hour load test at up to 100% rated load. Conduct a 45 minutes battery discharge test
Connect load bank to UPS distribution panelboard.
 - .3 Training - provide separate training program organized to suit schedules of operating personnel.

PART 3 - EXECUTION

- 3.1 INSTALLATION COORDINATION
- .1 Physical installation details shown on plans and defined in these Specifications are typical of equipment which would conform to Specifications for equipment supply.
 - .2 Coordinate with actual UPS equipment supplier for all final installation dimensions, locations, connections, and miscellaneous installation materials.
 - .3 Obtain approval from Departmental Representative for any significant changes in equipment location or connection.
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- 3.2 ELECTRICAL SYSTEM .1 Make all necessary electrical connections to UPS equipment and accessories as shown on electrical plans and suppliers' drawings.
- 3.3 COMMISSIONING THE WORK .1 Following completion of installation, the UPS Equipment Supplier is required to provide a qualified representative for commissioning, testing, and training for UPS and associated equipment. Schedule and coordinate these activities with the UPS supplier.
- .2 Ready UPS system for service. Check phase rotation of UPS output prior to switching loads.
- .3 Qualified personnel shall commission system for correct operation and suitability for service.
- .4 Departmental Representative shall be notified and a date set for Site Acceptance Test.
- 3.4 SITE ACCEPTANCE TEST .1 Coordinate and conduct Site Acceptance testing in conjunction with the UPS Equipment Supplier. This testing will consist of:
- .1 Commissioning and operational tests.
- .2 Acceptance tests to be conducted after loads are connected to the new UPS distribution panel.
- .2 For commissioning and operational tests, operate for 2 hours, running at available building load. Conduct test and observe/record test data. Verify to the Departmental Representative that commissioning tests were satisfactorily completed and equipment is ready for acceptance tests.
- .3 For load acceptance tests, provide, install, connect, and operate an adjustable capacity resistive load bank.
- .4 Following the load test, conduct a 45-minute battery discharge test. Battery voltage and DC current shall be recorded at 1-minute intervals during the test. Should the batteries fail to meet the specified requirements, replace the entire battery bank with all new batteries and repeat the tests until satisfactory.
- .5 Maintain test record sheets which record test conditions and logged data. Recordings and test
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- 3.4 SITE ACCEPTANCE TEST (Cont'd)
- .5 (Cont'd)
record format shall be neat and readily legible.
Provide copies for inclusion in instruction manuals.
- .6 Following satisfactory completion of Site Acceptance Test, put equipment in permanent automatic service.
- 3.5 TRAINING
- .1 Conduct a familiarization and training session for operating personnel. Schedule training session to coordinate with shift schedules of operating personnel.
- .2 Training shall be conducted by a qualified UPS service technician who is familiar with both technical and operating/service characteristics of UPS systems.
- .3 Session to be conducted after equipment is installed and fully operational.
- .4 Include a minimum of the following items:
.1 Familiarization with instruction manual.
.2 Review of electrical schematics and controller logic ladder diagram - how to read them and how to use them to troubleshoot system function or control problem.
- .5 Physical check-over of equipment noting device locations and relationship to schematics.
.1 Equipment functional tests and checks.
.2 Equipment operating instructions, including tuning and adjusting for operation.
.3 Equipment routine service requirements.
.4 Emergency troubleshooting instructions - define most likely problems, symptoms, and corrective actions.
.5 Battery system safety, operation, and maintenance.
- .6 Operating personnel will be a maximum of 4 persons who will be qualified electricians and/or electronics service personnel.