MITSUBISHI ELECTRIC

2033D SERIES
(30, 50, 80kVA)

SPECIFICATIONS

U-ENS00014A

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1.   SCOPE

1.1   The System

This specification describes an on-line, three phase, solid-state, uninterruptible power system, hereafter known as the UPS. The UPS shall operate utilizing the existing power distribution system to provide a high quality, reserve source of power to electronic equipment loads. The system shall consist of a converter, system battery, solid-state inverter, automatic static bypass transfer circuit and integral maintenance bypass circuit.

2.   SYSTEM DESCRIPTION

2.1   Components

The UPS shall be comprised of the major components listed below:

2.1.1   **Insulated Gate Bipolar Transistor/Intelligent Power Module (IGBT) Converter Section.**

2.1.2   **Insulated Gate Bipolar Transistor/Intelligent Power Module (IGBT) Inverter Section.**

2.1.3   Digital Signal Processor (DSP) using pulse Width Modulation (PWM) control for Direct Digital Control (DDC) of all UPS control and monitoring functions.

2.1.4   Static bypass switch sized to provide fault clearing.

2.1.5   Standard features:

    a.   Transistorized PWM IGBT Converter.
    b.   Transistorized PWM IGBT Inverter.
    c.   UPS output isolation transformer.
    d.   DSP based fault memory and diagnostics.
    e.   DSP based menu controlled operation.
    f.   EMI filters on Input, Bypass and Output.
    g.   Surge Suppression on Input and Bypass circuit.
    h.   Active mitigation of reflected input harmonics (no passive filters).
    i.   Active control of output voltage distortion (no passive filters).
    j.   Internal DC Disconnect and Fuse protection.
    k.   Input AC Disconnect and Fuse protection.
    l.   Static Bypass Disconnect.

m.   Internal Maintenance Bypass Switch (MBS).
n.   Automatic input current walk-in.
o.   Remote operation (Start/Stop of Inverter).
p.   Automatic UPS restart and load pick-up (after system battery depleted; AC restored).
q.   Programmable external customer contacts (C-Type) dry contacts.
r.   RS232C communication for "DiamondLink" monitor software.
s.   Web monitor (RJ45)
t.   Touch screen person-machine interface.
u.   Remote and Local Emergency Power Off (EPO).
v.   Battery self test
w.   Battery Temperature Compensation

2.1.6   Optional features:

a.   Remote monitor panel.
b.   Input Isolation Transformer.
c.   External Maintenance Bypass Switch.
d.   Two parallel redundant system.

2.2   Modes of Operation

The UPS shall be designed to operate continuously at rated capacity as an on-line, automatic system in the following modes:

2.2.1   Normal - The inverter continuously supplies AC power to the critical load. The converter converts commercial AC power to regulated DC power which then serves as the inverter input and, simultaneously, as a float charge input to the storage battery.

2.2.2   Emergency - In the event of a commercial AC power failure, the inverter shall derive its input from the system battery, thus providing uninterrupted power to the critical load. This transition shall be accomplished without any switching or coupling, and with no interruption of power to the critical load from either a failure or restoration of the commercial AC power.

2.2.3   Recharge - Subsequent to restoration of commercial AC power, the converter shall automatically reactivate and provide DC power to the inverter, simultaneously recharging the system battery. This occurs automatically and without interruption to the critical load.

2.2.4   Bypass - In the event that the UPS must be taken off line due to an overload condition or UPS failure, the critical load shall be transferred to the bypass source via the static switch without interruption of power to the critical load. The static switch shall only be utilized for automatic emergency transfers. A re-transfer from bypass to inverter shall be performed automatically in overload conditions. A re-

transfer shall be inhibited if satisfactory synchronization of the inverter and bypass is not accomplished.

2.2.5　Two (2) Parallel Redundant / Non-Redundant Mode (option) - If one of the UPS modules are taken off line, but the load demand does not exceed the capacity on the UPS's remaining on-line, the system shall continue to furnish conditioned power from the inverter and operate in a Non-Redundant mode. Emergency and Bypass Modes shall operate as described above.

2.2.6　Remote - The UPS logic shall be capable of remote operation allowing activation of the following functions from a remote location:

    a.   Inverter stop.
    b.   Inverter start.
    c.   Emergency power off.

2.2.7　Maintenance Bypass – The UPS system shall be equipped with an internal MBS to allow safe and reliable maintenance of the UPS. The MBS shall be of the Make-Before-Break, "Zero Energy" type to ensure maximum load reliability and personnel safety.

2.3　Applicable Standards

The UPS has been designed in accordance with, and complies to, the following standards:

a.   UL 1778 and CSA 22.2 (cUL equivalent).
b.   IEC, Semiconductor Converter Standards (#62040-3.2.16).
c.   IEEE 587, ANSI C62.41
d.   EMI Compatibility: FCC Title 47, Part 15, Subpart B
e.   ISO 9001 Quality Assurance program.
f.   This specification.

3.　PERFORMANCE CHARACTERISTICS

3.1　Power Ratings

The UPS output capacity shall be:

XXX kVA/ **XXX** kW @ .8 pf lagging

3.2 Input (Converter)

3.2.1 Nominal input voltage: 480V, 3 phase, 3 wire.

3.2.2 Input voltage range: +10%, -15% at 100% load. –15% to –30% at derating load.

3.2.3 Input frequency and range: 45.4 Hz to 65Hz.

3.2.4 **Input power factor: .98 lagging typical at 100% load; 0.97 lagging typical at 50 % load.**

3.2.5 **Converter input current THD: 4% typical at 100% load. 7% typical at 50% load**.

3.2.6 Converter walk-in time: 10 seconds.

3.3 Input (Bypass)

3.3.1 Nominal input voltage: 480V, 3 phase, 3 wire.

3.3.2 Input synchronization voltage range: ± 10% of nominal.

3.3.3 Input frequency tracking range: 60 Hz ± 5% maximum.
The synchronous range shall be selectable 1% to 5% in increments of 1%.

3.3.4 Magnetized sub-cycle inrush current: typically 9 times normal full load current**.**

3.4 Output

3.4.1 Nominal output voltage: 480, 208 V, 3 phase, 4 wire.

3.4.2 Nominal dynamic voltage regulation:

- a. ± 1% for balanced loads.
- b. ± 2% for 100% unbalanced loads.

3.4.3 Manually adjustable output voltage: ± 5% range.

3.4.4 Voltage transient response: Voltage transient response shall not exceed the following, and shall recover to within nominal voltage regulation limits within 16.6 msec:

- a. ± 3% for a 100% load step.
- b. ± 1% (loss or return of AC input).
- c. ± 3% (inverter ⇔ bypass).

3.4.5 Output frequency (inverter synchronous): 60 Hz (tracks frequency of static bypass source).

3.4.6 Output frequency slew rate (inverter synchronized to static bypass): 1 Hz/second to 10Hz/second (selectable).

3.4.7 Free running output frequency (on battery or asynchronous): 60 Hz +/- 0.05%.

3.4.8 Output voltage harmonic distortion:

   a.   Typically 2% THD with 100% linear load.
   b.   Typically 5% THD with 100% non-linear load.

3.4.9 Load power factor range: 0.7 lagging to 1.0 within kW rating of UPS.

3.4.10 Output overload capability:

   106% to 150% for 1 min. (voltage regulation maintained).

3.4.11 Output fault clearing: typically 1000% for 1 cycle (utilizing bypass source).

3.4.12 The inverter shall have an output contactor to isolate the inverter from the load and bypass source.

3.5   Environment

The UPS shall be capable of withstanding any combination of the following external environment conditions without mechanical damage, electrical failure or degradation of operating characteristics.

3.5.1 Efficiency:

UPS capacity (kVA)	Battery to AC (%) (100% Load)	AC to AC (%) (100% Load)
30	89	90
50	90	90
80	91	90

3.5.2 Ambient operating temperature range: 0 to +40 degrees °C (no derating required).

3.5.3 Recommended operating temperature range: +15 to +25 degrees °C.

3.5.4 Storage temperature   (non-operating): -20 to +70 degrees °C.

3.5.5 Relative humidity

a.   Maximum operating range: 5% to 95% (non-condensing).
b.   Recommended operating range: 30% to 90%.

3.5.6   Altitude: Operating to 9,000 feet No derating.

3.5.7   Heat dissipation (at 100% load).

UPS capacity (kVA)	kBTU/hr	kW
30	9.1	2.7
50	15.2	4.4
80	24.3	7.1

3.5.8   Acoustical noise level:

65 dBa @ 1 meter

3.6   Reliability

The UPS equipment reliability shall be represented in terms of theoretical Mean-Time-Between-Failures (MTBF). The UPS manufacturer shall, as a minimum, provide the following capability. (Based on MIL-STD-217F)

3.6.1   Total single module UPS system output (includes reliability of bypass circuit):

229,000 MTBF hours.

3.6.2   Single module UPS operation (represents UPS module operation only):

32,000 MTBF hours.

3.7   Maintainability

MTTR of the UPS shall not exceed 1 hour including time to replace components.

3.8   System Battery

The system battery shall be sized to provide the specified back-up time to the inverter when the UPS is supplying 100% rated load. The battery shall be of the VRLA, Flooded Lead Acid or Nickel Cadmium types.

3.8.1 <u>VRLA Battery System Example (EXAMPLE using 50 kVA UPS)</u>

a. The battery system shall include a DC cable landing box equipped with sufficient landing provisions to interface the UPS' DC input to battery cabinets.

b. The battery shall be capable of operating in an average ambient temperature of 25 °C, with excursions of 16 °C to 32 °C and shall be sized as follows:

1. Float voltage: 540 VDC
(2.25 to 2.27 V/cell)
2. Final voltage: 400 VDC
(1.67V/cell)

4. FUNCTIONAL DESCRIPTION

4.1 Converter

4.1.1 General

The Converter shall convert the incoming AC power into regulated DC power to supply the inverter input and system battery. The Converter shall utilize the following technologies:

a. Solid state **PWM controlled IGBT power transistors switching at 8 kHz.** Switching shall be defined as IGBT turn on and turn off rate. Doubling of frequency at inverter output shall not be considered as the true switching frequency.
b. **Input Power: Rated kVA at 1:1 ratio.**
c. **DSP based control logic.**

4.1.2 Input Current Limit

The Converter logic shall provide input current limiting by limiting the AC input current. The line-side current transformers shall be employed as a means of sensing the current amplitude. The Converter logic shall also be capable of providing auxiliary current limiting when the logic is signaled to do so via an external dry contact closure (e.g.; UPS fed from motor generator). It shall also provide sufficient capacity to provide power to a fully loaded inverter while simultaneously recharging the system battery to 90% of full capacity within 10 times the discharge time. The DC output current limit values are as follows:

a. Converter input current (maximum) 115% of nominal.
b. Converter input power (maximum) 100% of rated kVA.

   c.   Converter input current (aux.) 10%-150% variable.

4.1.3 Battery Charge Current Limit

The Converter logic shall provide DC battery current limiting for controlled battery charging. The battery current sensing shall be independent of the Converter DC output current sensing to provide precise battery recharging. The following battery current limits shall be provided as a minimum:

   a.   Primary battery charge current limit: 1% to 40% (adjustable) of battery Ah rate.
   b.   Second step battery charge current limit: 1% to 40% (adjustable) of battery Ah rate. Activated by a dry contact signal.
   c.   Maximum charge kW: 30% of rated kVA at low load.

4.1.4 Voltage Regulation

The Converter output voltage shall not deviate by more than $\pm$ 1% RMS due to the following conditions:

   a.   From 0 to 100% loading.
   b.   Converter input variations of voltage and frequency within the limitations set in section 3.2.
   c.   Environmental condition variations within the limitations set in section 3.5.

4.1.5 Reflected Harmonic Content

The Converter shall not produce more than 4% reflected current distortion into the Converter input utility source when nominal voltage and rated load is applied. Typically, the amount of reflected current distortion shall not exceed 7% THD at 50 % load.

4.1.6 Automatic Input Walk-in

The Converter logic shall employ circuitry to allow a delayed and timed ramping of input current. Subsequent to energizing the Converter input, the ramping of current shall be delayed by a maximum of 10 second. Upon starting the walk-in process, the ramping of current shall be timed to assume the load gradually within 5 through 30 seconds (every 1 second selectable). This function shall be supplied as standard equipment.

4.1.7 Input Overload Protection

AC input contactor and fuses shall provide Converter input overload protection.

4.1.8 Equalize Charge Timer

   a)   Manual Equalize Charge Timer

The UPS logic shall provide a 100 hour maximum electronic manual equalize charge timer. The timer circuit, once activated, shall provide a high rate equalizing charge voltage to the system battery for the selected time. The circuit shall also be capable of manual activation or deactivation via the LCD touch panel

b) Automatic Equalize Charge Timer
Once equalizing voltage level is achieved as stated by the battery manufacturer (typically .04 to .08 VDC/cell higher than the specified float level) for a period of 10 minutes, the Converter output voltage shall return to the specified float voltage (typically 2.25 to 2.28 VDC/cell).

4.1.9   Battery Temperature Compensation

The UPS shall have, as standard equipment, a battery temperature compensation function allowing the Converter voltage to fold-back to a safe value in the event the battery temperature reaches a predetermined dangerous level.

4.1.10 Step load (0-100%) changes

100% step load changes shall use ONLY the Converter to supply power to the inverter. The batteries SHALL NOT be cycled at any time during these step load changes.

4.1.11 DC Ripple voltage

The DC buss rms ripple voltage shall be less than 1% of the UPS' *nominal* DC voltage level at *100% load and with no battery* connected. This shall provide for maximum battery life.

4.1.12 Battery Self Test (DiamondSense)

For a short duration of time, a small power discharge from the battery is automatically carried out. From this small power discharge, the Mitsubishi UPS evaluates the degradation of the battery. The following advantages are therefore achieved:

● The DiamondSense Battery Self-Test Function can be performed even when the load is on the inverter
● Due to the short duration small power discharge there is no effect to the battery life expectancy
● The small power discharge has negligible effect on the overall battery back up time. The small power that is discharged by the battery will quickly be replenished

4.2   Inverter

4.2.1 General

The Inverter shall generate AC power that is derived from DC power supplied from the Converter or the system battery. The Inverter shall be capable of providing rated output as stated in section 3.4 while operating from any DC voltage within the battery operating range. The Inverter shall utilize the following technologies:

    a.   Solid state PWM controlled IGBT power transistors switching at 8 kHz. Switching shall be defined as IGBT turn on and turn off rate. Doubling of frequency at inverter output shall not be considered as the true switching frequency.

    b.   DSP based control logic.

4.2.2 Voltage Regulation

The Inverter output voltage shall not deviate by more than +/- 1% RMS due to the following steady state conditions:

    a.   0 to 100% loading.

    b.   Inverter DC input varies from maximum to minimum.

    c.   Environmental condition variations within the limitations set in section 3.5.

4.2.3 Frequency Control

The Inverter output frequency shall be controlled by an oscillator internal to the UPS module logic. It shall be capable of synchronizing to an external reference (e.g.; the bypass source) or operating asynchronously. The oscillator shall maintain synchronization with the external reference within the limitations set in section 3.3.3. A message located on the touch screen shall identify the loss of synchronization. Synchronization shall be maintained at 60 Hz $\pm$ 0.05% continuously. The Inverter output frequency shall not vary during steady state or transient operation due to the following conditions:

    a.   0 to 100% loading.

    b.   Inverter DC input varies from maximum to minimum.

    c.   Environmental condition variations within the limitations set in section 3.5.

4.2.4 Output Harmonic Distortion

The Inverter output shall limit the amount of harmonic content to the values stated in section 3.4.8. The use of excessive or additional filtering shall not be required to limit the harmonic content thus maintaining a high level of efficiency, reliability and original equipment footprint.

4.2.5 Output Overload Capability

The Inverter output shall be capable of providing an overload current while maintaining rated output voltage to the values stated in section 3.4.10. A message

indicating LED located on the control panel shall illuminate to identify this condition. If the time limit associated with the overload condition expires or the overload is in excess of the set current amplitude, the load power shall be transferred to the bypass source without interruption.

4.2.6 Inverter Current Limit

The Inverter output shall also be limited to 150% of rated load current. The two sensing locations shall operate separately and independently thus providing redundancy and, in the event of a failure, prevent unnecessary damage to power transistor components/fuses. Load current above 150% shall cause an immediate transfer of the load to the bypass source for fault clearing.

4.2.7 Inverter Overload Protection

The Inverter AC output shall utilize electronic current limiting for overload conditions. The Inverter shall utilize a contactor to isolate its output from the critical bus.

a.   The Inverter fuses shall be the fast acting semiconductor type to clear faults on the AC buss.
b.   The Inverter output isolation contactor shall be located internal to the UPS module and shall be controlled by the internal UPS module system logic.

4.2.8 Line Drop Compensation

The inverter shall be provided with circuitry such that its output voltage rises linearly with output current. The rise shall be required to achieve this function, and it shall not interfere with other requirements of this specification. The purpose of this feature is to compensate for varying line drop voltage between the inverter and the critical load.

4.3   Bypass and Static Switch

4.3.1 General

A bypass circuit shall be provided as an alternate source of power other than the inverter. A high speed SCR switch shall be used to assume the critical load during automatic transfers to the bypass circuit. The static switch shall derive power from an upstream bypass feed contactor internal to the UPS module. The bypass circuit shall be capable of supplying the UPS rated load current and also provide fault clearing current. The UPS system logic shall employ sensing which shall cause the static switch to energize immediately thus providing an uninterrupted transfer to the bypass source when any of the following limitations are exceeded:

a.   Inverter output undervoltage or overvoltage.

b.   Overloads beyond the capability of the inverter.
c.   DC circuit undervoltage or overvoltage.
d.   Final voltage of system battery is reached (bypass source present and available).
e.   System failure (e.g.: logic fail, fuse blown, etc.).

4.3.2   Automatic Re-transfers

In the event that the critical load must be transferred to the bypass source due to an overload, the UPS system logic shall monitor the overload condition and, upon the overload being cleared, perform an automatic re-transfer back to the inverter output. The UPS system logic shall only allow a re-transfer to occur three times within a one minute period. Re-transfers shall be inhibited on the fourth transfer due to the likely hood of a recurring problem at the UPS load distribution. The re-transfer of load to the inverter shall also be inhibited due to the limitations set in section 3.3. All retransfers will be inhibited if the inverter and static bypass line are not synchronized.

4.3.3   Manual Transfers

The UPS shall be capable of transferring the critical load to/from the bypass source via the front control panel. .   If performing manual transfers to inverter or automatic retransfers, the UPS system logic shall force the inverter output voltage to match the bypass input voltage and then parallel the inverter and bypass sources providing a make-before-break transition allowing a controlled walk-in of load current to the inverter. Manual transfers will be inhibited if the inverter and static bypass line are not synchronized.

4.3.4   Static Switch

The static switch shall be a high speed transfer device comprised of naturally commutated SCR's.

5.   OPERATOR CONTROL PANEL

5.1   Operator Controls

The operator control panel shall employ the use of a touch screen interface which allows lock-out of all UPS control functions for security (the Emergency Power Off function shall not be locked-out). The operator interface shall provide the following:

a.   UPS start-up procedure
b.   UPS shutdown procedure
c.   Emergency Power Off (EPO)

d.	Audible alarm silence
e.	System status levels

## 5.2	Remote Operation

Certain UPS controls shall, as standard equipment, be capable of being operated from a remote location. The remote functions are provided for user convenience and shall be activated via, user supplied, external dry contact switches connected at the user interface wiring terminal. The following remote control functions shall be provided as a minimum:

a.	Inverter start.
b.	Inverter stop.
c.	Emergency Power Off.

## 5.3	Mimic Bus Display

A mimic bus identifying the internal UPS power circuit, contactors/circuit breakers, operating status and fault conditions shall be provided on the touch screen interface. The following display shall be included:

a.	Converter operation.
b.	Battery operation.
c.	Converter on/off.
d.	Inverter on/off.
e.	Inverter synchronized with bypass.
f.	Load on inverter.
g.	Load on bypass.
h.	Equalize charge on.

## 5.4	Microprocessor Interface/Diagnostics

5.4.1	Microprocessor Controlled Operator Guidance

The UPS' microprocessor logic shall, as standard equipment, provide menu-driven operator instructions detailing the operation of the UPS system. The instruction menu shall be accessible via a touch screen display located at the control panel. The microprocessor shall monitor each step, thus prompting itself to the next step of the instructions. The following instructions shall be available as a minimum:

a.	Inverter stop.
b.	Inverter start.

c.   UPS shutdown.
d.   UPS startup
e.   Transfer of load to static bypass.
f.   Equalize charge to system battery.

5.4.2 Microprocessor Controlled Metering

All meters shall be digitally displayed having an accuracy of 1% or better. The following parameters shall be available for display:

a.   Converter input voltage (A-B phases)
b.   Converter input frequency
c.   Battery voltage
d.   Battery charging/discharging current
e.   Battery capacity remaining during power failure conditions
f.   Bypass input voltage (A-B phase)
g.   Output voltage (all phases including line-line and line-neutral)
h.   Output frequency
i.   Output current in RMS Amps and % Amps (all phases including line and neutral)
j.   Load Effective Power (Real, kW)
k.   Load Power factor

5.4.3 Microprocessor Controlled Diagnostics

The UPS shall provide microprocessor controlled diagnostics capable of retaining fault alarms along with metering parameters in the event of a UPS failure. The microprocessor memory data shall be viewed via an LCD display located at the control panel. The following alarm/status information shall be provided as a minimum:

a.   AC Input Contactor Condition (Open or Closed)
b.   Converter Input out of Range
c.   Converter Operation
d.   Converter Supplying DC Power
e.   DC (Battery) Contactor Condition (Open or Closed)
f.   Battery Operation
g.   Battery Low Voltage
h.   Battery Depleted
i.   Battery Temperature Abnormal
j.   Battery Charge/Discharge Operation
k.   Equalize Charge Activated
l.   Inverter Operation
m.   Inverter Stop due to Overload Condition
n.   Inverter Running Synchronously
o.   Inverter Running Asynchronously

p.	Inverter Output Contactor Condition (Open or closed)	
q.	Output Overload	
r.	Remote Start/Stop Enabled	
s.	Remote Operation	
t.	Static Bypass Input out of Range	
u.	Load on Inverter	
v.	Load on Static Bypass	
w.	Minor Fault	

6. CONTROL LOGIC POWER

The UPS control logic power supply shall employ a redundant design utilizing the UPS utility input, the Bypass input and the Inverter output.

7. UPS STATUS INTERFACING

7.1 User Selectable Output Contacts

The internal UPS logic shall provide, as standard equipment, a programmable one (1) set of nine (9) normally open and normally close dry contact outputs to allow user interfacing of the UPS operating status. The available parameters are identical to the alarm and status information schedule itemized from the following parameters:

1.	Minor Fault
2.	Load on Inverter
3.	Load on Bypass
4.	Battery Operation
5.	Converter Operation
6.	Battery Low Voltage
7.	Output Overload
8.	AC Input out of Range
9.	Static Bypass Input out of Range
10.	Battery Depleted
11.	Battery Temperature Abnormal
12.	Battery Equalizing charge
13.	Inverter Running Synchronously
14.	Inverter Running Asynchronously
15.	Minor Alarm
16.	Total Alarm (Minor, Major and Alarm)
17.	Remote operation enable

7.2   User Selectable Input Ports

The UPS shall have, as standard equipment, nine (9) selectable input ports. The user can select from the following parameters:

1. Remote Start
2. Remote Stop
3. Battery Temperature Abnormal
4. Power Demand
5. Another UPS Converter Operation
6. Asynchronous Command
7. Charger Stop
8. Second Step Battery Charge Current Limit
9. Battery Equalizing Charge

7.3   RS232C/RS485 Communication

The UPS shall have, as standard equipment, an RS232C/RS485 smart port allowing the user to interface the UPS status information to a host computer. "DiamondLink" monitoring software, or equivalent, shall be available to support the specified operating system. Field installed, and field tested RS232C/RS485 additions shall not be accepted.

7.4   Waveform capture trace information

Upon UPS failure, a trigger will initiate capture of UPS Module Waveform, logic and control signals. The capture duration will be for 10 cycles, 5 cycles pre trigger and 5 cycles post trigger. The sampling frequency shall be 7.2kHz, therefore a total of 120 samples per cycle will be taken. The captured data can be downloaded to a PC and displayed on Mitsubishi Electric Software. The Software allows selection of UPS Module Waveform, logic and control signals for display and zoom functions. Waveform capture information assists service personnel for troubleshooting and undertaking UPS Module failure root cause analysis

8.   OPTIONAL EQUIPMENT

8.1   Remote Status Alarm Panel (RSAP)

The UPS manufacturer shall offer a Remote Status Alarm Panel which shall not allow any control over the UPS. **The RSAP shall have, as standard equipment, a battery backup feature allowing it to continue monitoring UPS status conditions during power outage situations.** The RSAP shall act only as an annunciation panel providing the following alarms/indications as a minimum:

    a.   Converter ON
    b.   Load on Inverter
    c.   Load on Bypass
    d.   UPS Failure
    e.   Output Overload
    f.   UPS in battery back-up mode
    g.   Low battery while in back-up mode

9. MECHANICAL DESIGN

9.1 Enclosure

The UPS shall be equipped with standard forklift provisions to allow ease of installation using conventional lifting/moving equipment. All UPS enclosures shall require a special tool or screw driver to allow internal access.

9.2 Serviceability

The UPS shall have front access only for maintenance or service. Side access or rear access shall not be accepted. The UPS shall be designed such that its rear can be pressed against a back wall and its sides can be pressed against side walls.

9.3 Ventilation

Forced air cooling shall be provided to allow all components to operate within their rated temperature window. Thermal relays, using a latched contact which is capable of being reset, shall be used as overload protection to all cooling fans. Each fan shall employ a separate thermal relay. All air inlets use washable air filters that shall be removable from the front of the UPS without exposure to any electrical hazard. Air filters shall be door mounted to prevent floor dust from being sucked into the unit. Bottom mount air filters shall not be accepted.

9.4 *Printed Circuit Boards*

All printed circuit boards shall be conformally coated against corrosive vapors and to hermetically seal them.

9.5 *Bussbar*

All bussbar used for conductivity within the UPS shall be designed with COPPER ONLY (Aluminum not acceptable)

9.6 *Paint Color*

Munsell 5Y7/1.

10. Factory Test Report

All UPS units shall come equipped with one (1) factory test report included in the UPS. The factory test report shall include the following:

 a. Series/kVA
 b. Serial Number
 c. Date of test
 d. Approved by/Inspected by/Tested by
 e. Inspection of Construction
 f. Checking of wiring (Black/Red marking on each connection point)
 g. Grounding Continuity
 h. Insulation Strength Test
 i. Control Circuit Operation
 j. Measurement of Steady State Characteristics (Voltage/current/efficiencies)
 k. Transient Characteristics (0-100% step load test without batteries/voltage fluctuation)
 l. Overload testing
 m. Transfer Switch operation