Fuji Electric Corp. of America
UPS Department

GUIDE SPECIFICATIONS
For a 300-500kVA
UPS7000HX-3U
Single Module Uninterruptible Power System

1.0 GENERAL

1.1 SUMMARY

These specifications describe requirements for an Uninterruptible Power System (UPS). The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption, during failure or deterioration of the normal power source.
The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental and space conditions at the site. It shall include all equipment to properly interface the AC power source to the intended load and shall be designed for unattended operation.

1.2 STANDARDS

The UPS shall be manufactured in accordance with and be compliant with the following sections of the current revisions of these standards:

- UL 1778 /cUL
- IEC61000-4-5 Level 4 (Surge Protection)
- IEC 62040-2 Cat. 3 (EMI/RFI)
- ISO 9001
- ISO 14001
- OSHPD
- Energy Star

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

The UPS shall be sized to provide a minimum of ____kVA/kW output (unity load power factor rating)
The UPS shall be able to supply all required power to full rated output kVA loads with power factor from 0.7 lagging to 0.95 leading.
Load voltage and bypass line voltage shall be 480VAC, three-phase, three-wire plus ground. Input voltage shall be 480VAC, three-phase, three-wire plus ground. The AC input source and bypass input source shall each be a solidly grounded wye service (Unless a high resistance ground requirement is indicated [see below]).
The rectifier AC input and bypass AC input may be fed from separate AC sources.
The battery shall support the UPS at 100% rated kW load for at least _____ minutes at 77°F (25°C) at startup.
The UPS shall have an active power factor-corrected IGBT converter/rectifier, capable of maintaining input power factor and input current total harmonic distortion (THDi) within specifications without an additional input filter.
The UPS shall be of transformer-free design, requiring no internal transformer in the main power path for the basic operation of the module. Optional transformers in cabinets or otherwise external to the basic UPS module shall be permissible to provide isolation and/or voltage transformation.

The UPS shall be capable of operating in a High Resistance Ground environment, and shall provide notification when a fault to ground occurs on its output. Leakage current shall not exceed 1.5 amps.

1.3.2 Modes of Operation

The UPS shall operate as an on-line reverse transfer system in the following modes:

A. Normal: The critical AC load shall be continuously powered by the UPS inverter. The rectifier/charger shall derive power from the utility AC source and supply DC power to the DC-DC converter, which in turn shall supply the inverter while simultaneously float charging the battery.

B. Emergency: Upon failure of utility AC power, the critical AC load shall be powered by the inverter, which, without any switching, shall obtain its power from the battery plant via the DC-DC converter. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

C. Recharge: Upon restoration of the utility AC source, the rectifier shall supply power to the output inverter and to the DC-DC converter, which shall simultaneously recharge the battery. This shall be an automatic function and shall cause no interruption to the critical AC load.

D. Bypass: If the UPS must be taken out of service for maintenance or repair, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical AC load. An optional external wrap-around maintenance bypass shall be used to ensure full isolation of the unit for the service of internal components while providing safety from arc flash and in compliance with OSHA requirements.

E. Off-Battery: If the battery only is taken out of service for maintenance, it shall be disconnected from the DC-DC converter by means of an external disconnect circuit breaker. The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage backup time capability. If multiple battery strings are used, each string shall be capable of being electrically isolated for safety during maintenance.

1.3.3 Performance Requirements

The solid-state power components, magnetics, electronic devices and overcurrent protection devices shall operate within the manufacturer's recommended temperature when the UPS is operating at 100% critical load and maintain battery charging with either of the following conditions occurring:

- Any altitude within the specified operating range up to 6560 ft. (2000m) elevation
- Any ambient temperature within the specified operating range of 32°F to 104°F (0°C to 40°C)

1.3.4 Input

A. Voltage: Input/output voltage specifications of the UPS shall be:

- Rectifier AC Input: 480V, three-phase, three-wire-plus-ground
- Bypass AC Input: 480V, three-phase, three-wire-plus-ground
- AC Output: 480V, three-phase, three-wire-plus-ground

B. Voltage Range: +10%, -25% of nominal (minimum -10% at nominal load.) The UPS shall operate without discharging the battery at 80% of full nominal load with voltage down to -25% of nominal.

C. Frequency Range: 60Hz, +- 10%

D. Rectifier Walk-In: 0% to 100% of full rated load over 0-30 seconds (adjustable) with full rectifier power. The walk-in period shall begin within 2 seconds after initiation.

E. Rectifier Start Delay: Programmable from 0-163 seconds (adjustable) plus 2-second qualification period before walk-in begins.

F. Max Inrush Current: UPS inrush current peak not to 1000A

G. Power Factor: Minimum 0.99 at full load with nominal input voltage

H. Current Distortion: Less than 5% input current THD at rated load and nominal voltage in double-conversion mode, 500kVA UPS (5.5% for 400kVA, 7% for 300kVA)

I. Surge Protection: Sustains input surges w/o damage per criteria listed in IEC61000-4-5, Level 4

J. Short Circuit Current Withstand Rating: 100kAIC with optional Bypass Input Fuses

1.3.5 AC Output

A. Load Rating: 100% load rating at 104°F (40°C) for 8 hours for any load from 0.95 leading to 0.7 lagging; 100% of load rating continuous at 104°F (40°C).

B. Voltage Regulation:

- ±1% RMS average for a balanced three-phase load
- ±1.5% for 100% unbalanced load for line-to-line imbalances

C. Voltage Adjustment Range: ±5% for line drop compensation adjustable by factory service personnel.

D. Frequency Regulation:

- Synchronized to bypass: ±0.6Hz default setting, adjustable in 1% increments to +- 5%, by factory service personnel)
- Synchronized to internal clock 0.06Hz

E. Efficiency: Defined as output kW/input kW at rated lagging load power factor; and not less than the values listed below (select kVA rating for this specification), Energy Star Testing.

KVA Rating	25% Load	50% Load	75% Load	100% Load
300	94.4%	96.5%	97.0%	97.3%
400	95.4%	97.0%	97.3%	97.3%
500	96.1%	97.2%	97.3%	97.2%

F. Phase Imbalance:

- Balanced Loads: 120° ±1°
- 100% Unbalanced Loads: 120° ±3°

G. Voltage Transient Response (average of all three phases) 0-100% or 100-0% Load Step:

- Transient Voltage Deviation, RMS: ≤5%
- Transient Recovery: ±1% of nominal within 50 msec. (linear loads)
- Meets IEC 62040-3: 2011 Figure 2 Curve 1, Class 1
- Meets ITIC and CBEMA Curve Requirements

H. Voltage Harmonic Distortion:

- Maximum 2% RMS total (100% resistive load)
- Maximum 5% RMS total (100% non-linear load)

I. Overload at full Output Voltage with ±1% voltage regulation:

- 100% continuously
- 125% of full load for 10 minutes
- 150% of full load for a maximum of 60 seconds

J. Current Limit:

- 200% nominal current including a bolted fault condition without bypass for up to 10 milliseconds and 150% for <60 seconds and 125% for <10 minutes.

K. Fault Clearing:

- Inverter only: 200% of normal full load current for 3 seconds or 150% of normal full load current for <60 seconds or 125% of normal full load current for <10 minutes (when bypass is not available).
- Bypass available: 1000% for 1 cycle.
- The UPS shall supply current from the inverter until the inverter overload time expires, and then shall supply current from the bypass to clear the fault.

1.3.6 Grounding

The UPS chassis shall have an equipment ground terminal.

1.4 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

- **UPS:** 32°F to 104°F (0°C to 40°C)
- **Battery:** 77°F (25°C), ±5°F (±3°C)

B. Storage/Transport Ambient Temperature

- 5°F to 131°F (-15°C to 55°C)

C. Relative Humidity

- 5 to 95%, non-condensing

D. Altitude

- **Operating:** To 6560 ft. (2000m) above Mean Sea Level without de-rating. Consult factory for de-rating above 6560 ft. (2000m) elevation.
- **Storage/Transport:** To 50,000 ft. (15,000m) above Mean Sea Level

E. Audible Noise Level

- 75dBA measured 3 ft. (1.0m) from the surface of the unit

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal shall include:

- System configuration with single line diagram.
- Description of equipment to be supplied including deviations from these specifications.
- Detailed layouts of customer power and control connections.
- Functional relationship of equipment, including weights, dimensions and heat dissipation.
- Size and weight of shipping units to be handled by contractor.
- Detailed installation drawings including all terminal locations.

1.5.2 Delivery Submittals

Submittals upon UPS delivery shall include:

- A complete set of submittal drawings.
- Factory test report
- Installation and Owners Manuals.

1.6 WARRANTY

1.6.1 UPS Warranty

The UPS manufacturer shall warrant the unit against defects in workmanship and materials for 36 months after initial startup or 42 months after the shipping date, whichever comes first.

1.6.2 Warranty - End User

Warranties associated with items not manufactured by the UPS supplier but included as part of the system shall be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer's Qualifications

A minimum of 20 years' experience in the design, manufacture and testing of solid-state UPS systems shall be required.
The quality system for the engineering and manufacturing facility shall be certified to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

1.7.2 Factory Testing

Before shipment, the manufacturer shall fully and completely test the UPS unit to ensure compliance with the specification.
The UPS unit shall be tested at the system-specified capacity. Testing shall be done using load banks at part-load and the full kW rating of the unit.
Operational discharge and recharge tests to ensure guaranteed rated performance.
System operations such as startup, shutdown and transfers shall be demonstrated.
A certified copy of test results shall be available for each system as indicated on the order.

2.0 PRODUCT

2.1 FABRICATION

2.1.1 Materials

All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semiconductors shall be sealed. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front for service access.

2.1.2 UPS Internal Wiring

Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards. All bolted connections of bus-bars, lugs and cables shall be in accordance with requirements of the National Electric Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator.

2.1.3 Field Wiring

All field wiring power connections shall be to copper bus-bars for connection integrity. Bus-bars shall have adequate space to allow two-hole long-barrel compression type lugs forming a permanent connection between field wiring and field-installed lugs.

Provisions shall be made in the cabinets to permit installation of input, output and external control cabling using raceway or conduit. Provision shall be made for top and bottom access to input, output, bypass and DC connections. In conformance with the NEC, connection cabinets shall provide for adequate wire bend radius. Control and Connectivity wiring is from the top only.

2.1.4 Construction and Mounting

The UPS shall be in NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking and forklift handling. Maximum cabinet height shall be 78.7.in. (2000mm).
The UPS shall be NEMA Type 1-compliant, with front doors open to enable safe change of air filters without the need for shutdown.

2.1.5 Cooling

Adequate ventilation shall be provided to ensure that all components are operated well within temperature ratings. Temperature sensors shall be provided to monitor the UPS's internal temperature. Upon detection of temperatures in excess of the manufacturer's recommendations, the sensors shall cause audible alarms to be sounded and visual alarms to be displayed on the UPS control panel. An internal, factory-mounted sensor for UPS over temperature is provided and shall give an alarm if the temperature is above specified limits. Air filters shall be located at the point of air inlet and shall be changeable. No service clearance or ventilation shall be required in the rear of the system.

2.2 EQUIPMENT

2.2.1 UPS System

The UPS system shall consist of an IGBT power factor-corrected rectifier, DC-DC converter and three-phase, transformer-free inverter, bypass static transfer switch, bypass synchronizing circuitry, protective devices and accessories as specified. The specified system shall also include a battery disconnect breaker and battery system.

A. Surge Protection: The UPS shall have built-in protection against: surges, sags and overcurrent from the AC source.

2.2.2 Output Protection

The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting, current-limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off-line. The load shall be automatically transferred to the bypass line uninterrupted for an internal UPS malfunction. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

2.3 COMPONENTS

2.3.1 Rectifier

The term *rectifier* shall denote the solid-state equipment and controls necessary to convert alternating current to regulated direct current to supply the inverter and charge the battery. The DC output of the rectifier shall meet the input requirements of the inverter without the battery being connected.

A. Input Current Harmonic Distortion: The rectifier shall actively control and reduce input current distortion over the full operating range of the UPS without the need for an additional

passive input filter. Input current THD shall be less than 5% at rated load and nominal voltage in double-conversion mode (for 500kva; see section1.3.4 h for other kVA rating values).

B. Input Current Walk-In: The rectifier/charger shall provide a feature that limits, during the transfer from battery mode to on-line mode, the total initial power requirement at the input terminals to 0% of rated load and gradually increases power to 100% of full rating over the 5 to 30 second (adjustable) time interval with full rated rectifier power The walk-in period shall begin within 2 seconds after initiation.

C. Dynamic Current Input Limit Reduction: The rectifier, in conjunction with the other UPS controls and circuitry, shall adjust the current demanded for battery charging as a function of UPS wattage load and input voltage level.

2.3.2 DC-DC Converter

The term *DC-DC converter* shall denote the equipment and controls to regulate the output of the rectifier to the levels appropriate for charging the battery and to boost the battery voltage to the level required to operate the inverter. The DC-DC converter shall be solid-state, capable of providing rated output power, and for increased performance shall be a pulse width-modulated design and shall utilize insulated gate bipolar transistors (IGBTs). The DC-DC converter shall control charging of the battery. The AC ripple voltage of the charger DC shall not exceed 1.5% RMS of the float voltage.

A. Battery Recharge: In addition to supplying power for the load, the rectifier/charger shall be capable of supplying a minimum of 5% of the module full load power rating for recharging the battery. The battery recharge rate capability shall be sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time while running at 95% of full load at nominal voltage, provided that the battery can accept recharge at that rate. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

B. Overvoltage Protection: There shall be DC overvoltage protection so that if the DC voltage rises to the pre-set limit, the UPS shall shut down automatically and initiate an uninterrupted load transfer to bypass, or shall disconnect the battery via the DC breaker(s) in the battery string.

C. Temperature-Compensated Charging: The UPS shall adjust the battery charging voltage based on the battery temperature reported from external battery temperature sensors. When multiple sensors are used, the voltage shall be based on the maximum temperature measured. Excessive difference in the temperature measurements shall be reported and the charging voltage adjusted to protect the batteries from excessive current.

D. Battery Load Testing: The UPS shall be capable of performing battery load testing under operator supervision. To accomplish this, the rectifier shall reduce charging voltage to force the batteries to carry the load for a short time. If the curve of battery voltage drop indicates diminished battery capacity, the UPS shall display an alarm message. If the voltage drop indicates battery failure, the UPS shall terminate the test immediately and annunciate the appropriate alarms.

2.3.3 Inverter

The term *inverter* shall denote the equipment and controls to convert direct current from the rectifier or battery via the DC-DC converter to precise alternating current to power the load. The inverter shall be solid-state, capable of providing rated output power and, for increased performance, the inverter shall be a pulse-width-modulated design and shall utilize insulated gate bipolar transistors (IGBTs). To further enhance reliable performance and efficiency, the inverter shall not require an inverter output series static switch/isolator for the purposes of overload or fault isolation or transfers to bypass.

A. Overload Capability: The inverter shall be able to sustain an overload across its output terminals while supplying full rated voltage for up to 150% for 60 seconds. The inverter shall be capable of at least 200% current for short-circuit conditions including phase-to-phase, phase-to-ground and three-

phase faults. After the fault is removed, the UPS shall return to normal operation without damage. If the short circuit is sustained, the load shall be transferred to the bypass source and the inverter shall disconnect automatically from the critical load bus.

B. Output Frequency: The inverter shall track the bypass continuously, providing the bypass source maintains a frequency of 60Hz ±1% (0.6 Hz). The inverter shall change its frequency (slew rate) at less than 1Hz per second to maintain synchronous operation with the bypass. This shall allow make-before-break manual or automatic transfers. If the bypass fails to maintain proper frequency, the inverter shall revert to an internal oscillator, which shall be temperature compensated and shall hold the inverter output frequency to 0.1% from the rated frequency for steady-state and transient conditions. Drift shall not exceed 0.1% during any 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

C. Phase-to-Phase Balance: The inverter shall provide a phase-to-phase voltage displacement of no worse than ±3% with a 100% unbalanced load.

D. Battery Protection: The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown shall be initiated when the battery voltage has reached the end of discharge voltage. The battery end-of-discharge voltage shall be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time shall not be acceptable.

2.3.3 Inverter Bypass Operation

For times when maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload or malfunction, a bypass circuit shall be provided to isolate the inverter output from the load and provide a path for power directly from an alternate AC (bypass) source. The UPS control system shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass circuit shall consist of a continuous duty bypass static switch and an overcurrent protection device to isolate the static bypass switch from the bypass source. The bypass static switch shall denote the solid-state device incorporating SCRs (silicon-controlled rectifiers) and wrap around contactor that can automatically and instantaneously connect the alternate AC source to the load.

A. Static Bypass Switch: The static bypass circuit power circuit consists of an SCR switch with a wrap-around contactor. The high speed SCR switch and wrap around contactor shall be used to assume the critical load during automatic transfer to the bypass circuit. The wrap around contactor shall be electrically connected in parallel with the SCR switch and shall, at the same time as the SCR switch,, be energized and upon closure maintain the critical load feed from the bypass source. The SCR switch shall only be used for the time needed to energize the contactor and confirm the contactor closure. The hybrid bypass switch shall be rated for continuous operation at full rated load for highest reliability.

B. Automatic Load Transfers: An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload condition is sustained for a period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load to the inverter only after the load has returned to a level within the rating of the inverter source and the alarm has been acknowledged.

C. Backfeed Protection: As required by UL1778 and CSA, the static transfer switch shall not backfeed UPS power to the bypass distribution system while the UPS is operating on battery during a bypass power outage. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is disconnected or has failed. If a shorted SCR is detected, the static transfer switch shall be isolated by an internal automatic circuit breaker and an alarm message shall be annunciated at the UPS control panel. The load shall remain on conditioned and protected power after detection of a shorted SCR and isolation of the bypass static switch.

2.3.4 Display and Controls

A. UPS Control Panel: The UPS shall be provided with a microprocessor-based control panel for operator interface (may also be referred to as *User Interface*, or *UI*) to configure and monitor the UPS. The control panel shall be located on the front of the unit where it can be operated without opening the hinged front door. A backlit, menu-driven, full-graphics, color touch screen liquid crystal display shall be used to enter set points for the battery test (duration and end voltage), display system information, metering information, a one-line diagram of the UPS and battery, active events, event history, startup instructions and transfer and shutdown screens.

B. EPO switch: The UPS shall be equipped with an Emergency Power Off switch (EPO). The switch shall be located on the front of the unit where it can be operated without opening the hinged front door. It will be a mechanical push button with a miss-operation prevention cover.

C. Logic: UPS system logic and control programming shall be resident in a microprocessor-based control system with nonvolatile flash memory. Rectifier, inverter and system control logic shall utilize high-speed digital signal processors (DSPs). CAN bus shall be used to communicate between the logic and the User Interface as well as the options. Switches, contacts and relays shall be used only to signal the logic system as to the status of mechanical devices or to signal user control inputs. Customer external signals shall be isolated from the UPS logic by relays or optical isolation.

D. Metered Values: A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accuracy to ±1% of voltage, ±3% AC current. The following parameters shall be displayed:

- AC input frequency
- AC input voltage
- Bypass input frequency
- Bypass input voltage
- DC voltage
- Battery voltage
- Inverter output frequency
- Inverter output voltage
- Inverter peak current (%)
- Inverter electric power
- Inverter load factor
- Output frequency
- Output voltage
- Output current
- Accumulated operation time
- Battery back-up times

E. Power Flow Indications: A power flow diagram shall graphically depict whether the load is being supplied from the inverter, bypass or battery and shall provide, on the same screen, the status of the following components:

- AC Input Contactor
- Battery Circuit Breaker
- Inverter AC Output Breaker
- Bypass Contactor
- Static Switch
- Backfeed Contactor

F. Main Display Screen: The main display screen of the UPS shall be the default screen and shall provide the following information:

- System Status
- Warning Indicator
- Fault Indicator
- AC input frequency
- AC input voltage
- Bypass input frequency
- Bypass input voltage
- Battery voltage
- Inverter output frequency
- Inverter output voltage
- Inverter peak current (%)
- Inverter electric power
- Inverter load factor
- Output frequency
- Output voltage
- Output current
- Accumulated operation time
- Battery back-up times

G. Touch Screen Control Buttons: Buttons shall be provided to start and stop the inverter. A pop-up message requesting confirmation shall be displayed whenever a command is initiated that would change the status of the UPS. Other buttons shall be provided to reset faults and silence the alarm buzzer.

H. Event Log: This menu item shall display the list of events that have occurred recently while the UPS was in operation. The Event Log shall store up to 128 events, with the oldest events being overwritten first if the capacity is reached.

I. Measures Menu: A "measures menu" shall provide access to the full set of measurements for each functional block (AC Input, bypass, DC-DC converter, batteries, inverter and load).

J. Battery Status Indicator: A battery status indicator shall display DC alarm conditions, battery state of charge, the present battery voltage, total discharge time, status of last battery test. The UPS shall provide the operator with controls to perform the following functions:

- Configure and manage manual battery test.
- Setting Test Date of Automaticity Test
- Start battery test
- Monitor test status and progression
- Stop battery test
- Battery test status

K. Alarms: The control panel shall report the system-level alarms listed below. An audible alarm shall be activated when any of the following alarms occurs. All alarms shall be displayed in text form.

- ACR STOP
- INV SUBCYCLE STOP
- INVERTER UV
- UPS OUT UV
- TEMP ALARM(INV)
- TEMP ALARM(CHOP/BAL) TEMP ALARM(REC)
- BATTERY CHARGE SHORTAGE

- SEQUENCE ERROR (MCCBD ANSWER)
- BATTERY VOLTAGE LOW
- END OF BATTERY DISCHARGE
- BATTERY LOW LOAD DISCHARGE
- TEMP ALARM(BATTERY)
- TEMP ALARM(UPS)
- INPUT OV
- INPUT UV
- INPUT FREQ NG (LOW)
- INPUT FREQ NG (HIGH)
- INPUT REVERSE PHASE
- INPUT OPEN PHASE
- BYPASS UV
- BYPASS OV
- BYPASS FREQ NG (LOW)
- BYPASS FREQ NG (HIGH)
- BYPASS OPEN PHASE
- BYPASS REVERSE PHASE
- OVER POWER
- BATTERY DISCHARGE
- BATTERY REVERSED
- BATTERY LIFE ALARM
- OUTPUT OVER CURRENT
- BUS OVER CURRENT
- ACR OVER CURRENT

L. Controls: System-level control functions shall be:

- Start Inverter
- Stop Inverter
- Transfer to Inverter
- Transfer to Bypass
- Startup Screen
- Battery Test Set point Adjustment
- Initiate Manual Battery Test
- Reset (Fault Cleared)
- System Settings (Time, Date, Language, LCD Brightness)
- Audio Silence Command
- Alarm Reset Command

M. Load Transfers: Two touch-screen buttons (START INVERTER, STOP INVERTER) shall provide the means for the user to transfer the load to Bypass and back on UPS.

2.3.5 Self-Diagnostics

A. Event Log File: The control system shall maintain a log of the event conditions that have occurred during system operation. Each log shall contain the event name, event time/date stamp and a set/clear indicator.

2.3.6 Remote Monitoring Capability

A. Communication Cards: The UPS shall be equipped with one bay for an optional communication card.

- Optional Web/SNMP card, providing SNMP and Web-management capability, shall be available.

- Optional Modbus card shall be available.

B. Output Alarm Contacts: UPS shall have ten signal contact signals, seven of which will be programmable.

1. **Fixed contacts** shall be:
    - Total Alarm
    - Control Power Source Alarm
    - Load on Bypass
2. **Programmable contacts** shall be selectable from the following:
    - Normal Operation
    - Battery Operation
    - Load on Inverter
    - Battery Low Voltage
    - Output Overload
    - Minor Alarm
    - Major Alarm
    - UPS Operation
    - Inverter Synchronous with Bypass
    - Inverter Asynchronous with Bypass
    - Remote mode
    - AC Input failure
    - Rectifier failure
    - Inverter failure
    - Battery Temperature Alarm
    - End of Battery Discharge
    - Bypass Input failure

C. Customer Input Contacts: The UPS shall have four discrete programmable input contacts available for the input and display of customer-provided alarm points or to initiate a pre-assigned UPS operation. Each input can be signaled by an isolated external normally open contact. The following operations are selectable:

- Remote Inverter Start
- Remote Inverter Stop
- Remote Bypass Feed
- Battery Temperature High
- Remote EPO
- Battery Breaker ON Answer
- Battery Breaker Trip (Output)
- Load on Generator

The UPS system shall have a properly rated circuit breaker (600VDC) to isolate the batteries from the UPS module. This breaker shall be in a separate NEMA-1 enclosure or in a matching battery cabinet. When open, there shall be no battery voltage in the UPS enclosure. The UPS shall be automatically disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level or when signaled by other control functions.

2.3.7 Battery Plant

The battery plant shall comply with the specifications of:

A. Matching battery power pack,

B. Valve-regulated, sealed cell battery system on rack.

A. Matching Battery Power Pack (VRLA Battery): The battery power pack shall consist of sealed, valve-regulated batteries and a properly rated circuit breaker (500VDC nominal, 600VDC maximum) for isolating the battery pack from the UPS. The battery cells and disconnect breaker shall be installed and housed in a NEMA-1 cabinet, matching the UPS style and design. The battery system shall be sized to support a _____kW load for _____ minutes. The battery shall be lead-calcium, sealed, valve-regulated type with a 3-year full warranty and a 7-year pro rata warranty under full float operation. The battery design shall utilize absorbent glass mat (AGM) technology to immobilize the electrolyte.

B. Valve-Regulated, Sealed Cell Battery System on Rack: The battery shall be a lead-calcium, sealed, reduced-maintenance type with a three-year full warranty and a 7-year pro rata warranty under full float operation.

1. Ratings:

- Backup time: ____ minutes
- Load kW: ____kW
- Maximum Specific Gravity: _____
- Racks shall be ____-tier, certified for seismic zone ____.

2. Electrolyte Immobilization: The battery shall utilize absorbent glass mat (AGM) technology to immobilize electrolyte.

3. Alloys

Grids shall be manufactured of lead-calcium alloys to assure long life and consistently low gassing rate over the entire service life; all internal wetted parts shall be of similar non-antimonial alloy to preclude interfacial corrosion at the bonded area.

4. Plates

Both positive and negative plates shall be of the flat pasted plate design to ensure highly reliable electrical performance throughout the life of the battery. Positive plates shall be equipped with fibrous retention mats to inhibit the loss of active material as a result of repeated cycling.

5. Terminals

All batteries shall include copper inserted terminal posts allowing connector torque of 110 pound inches and copper-to-copper interface with the intercell connector (except for flashing). Terminal posts shall be of sufficient strength to support normal inter-tier or inter-step cabling without additional bracing.

6. Container

The cell container and cover shall be of a flame-retardant material with an oxygen index of at least 28. The cell cover shall include a low-pressure release vent. All cells larger than .25 kW/cell (15-minute rate to 1.67 volts per cell) shall include an integral flash arrestor.

7. Inter-cell Connections

For each bolted connection, tin-plated copper connectors and corrosion-resistant bolts shall be provided; interconnecting hardware shall be sized so as to permit discharge at the maximum published rate while allowing no more than 30 mV of voltage drop between adjacent units at the one-minute rate to 1.75 volts per cell (VPC). Along with the necessary hardware, the supplier shall furnish terminal connection coating compound if required by the battery manufacturer.

8. Manufacturing Controls

Each cell shall be clearly identified as to cell type, voltage and capacity as well as manufacturing control group for future quality assurance traceability. All cells in the battery shall be tested to verify 100% system capacity. The equipment shall be designed and manufactured under a quality assurance program that is controlled and documented by written policies, procedures or instructions and that shall be carried out throughout the performance of the work. The quality assurance program shall conform to the requirements of ANSI N45.2, MIL I-45208A and MIL-Q-9858.

2.3.8 Optional Accessories

A. Remote Alarm Panel: The remote alarm panel shall have LED alarm lights. An audible alarm shall sound upon any alarm condition. The surface-mounted NEMA 1 enclosed panel shall indicate:

- Load on UPS
- Load on Bypass
- Battery Discharging
- Low Battery Warning
- Overload
- Audible Alarm with Reset

B. Web/SNMP Card: A Web/SNMP card shall be provided to Web function and Mailing function. Web function; The UPS status can be monitored and settings changed by using a browser such as Internet Explorer. Mailing function; the destination of mails to be transmitted at the time of UPS events, failures, and periodic communications can be freely set by the UPS user.

C. Modbus Card: Modbus card shall be provided to deliver Modbus 485 communication for remote monitoring. The UPS status, measurement information, etc. can be monitored on a communication system that works by Modbus protocol.

D. Seismic Anchorage Kits: Seismic anchorage kits shall be provided with the UPS unit, and if included the Optional Matching Battery Cabinet, for use in seismic restraint as required for IBC 2012 or OSHPD certification.

E. Scalable Output Capacity: UPS rated output capacity of certain models shall be scalable by means of a software upgrade available for purchase from the manufacturer which will require no hardware modifications to the UPS. Models shall be available in capacity ranges of 300, 400 and 500kVA.

- 300kVA model shall be scalable from 300 kVA to 400kVA and 500kVA.
- 400kVA model shall be scalable from 400kVA to 500kVA.

F. External Maintenance Bypass Panel: The Maintenance Bypass Panel can be either Wall mounted or Floor mounted, it shall be available with either 2 or 3 breakers and can have the option of being supplied kirk-key interlock system, either mechanical or with a Solenoid Key Release System.

3.0 EXECUTION

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

3.1.1 Visual Inspection

1. Inspect equipment for signs of damage.
2. Verify installation per drawings supplied with installation manuals or submittal package.

3. Inspect cabinets for foreign objects.
4. Verify that neutral and ground conductors are properly sized and configured per Fuji Electric Corp. requirements as noted in FEA drawings supplied with installation manuals or submittal package.
5. Inspect all cell cases.
6. Inspect each cell for proper polarity.
7. Verify that all printed circuit boards are configured properly.

3.1.2 Mechanical Inspection

1. Check all control wiring connections for tightness.
2. Check all power wiring connections for tightness.
3. Check all terminal screws, nuts and/or spade lugs for tightness.

3.1.3 Electrical Inspection

1. Check all fuses for continuity.
2. Confirm input and bypass voltage and phase rotation are correct.
3. Verify control transformer connections are correct for voltages being used.
4. Ensure connection and voltage of the battery string(s).

3.2 UNIT STARTUP

1. Energize control power.
2. Perform control/logic checks and adjust to meet FEA specification.
3. Verify DC float and equalize voltage levels.
4. Verify DC voltage clamp and overvoltage shutdown levels.
5. Verify battery discharge, low battery warning and low battery shutdown levels.
6. Verify fuse monitor alarms and system shutdown.
7. Verify inverter voltages and regulation circuits.
8. Verify inverter/bypass sync circuits and set overlap time.
9. Perform manual transfers and returns.
10. Simulate utility outage at no load.
11. Verify proper recharge.

3.3 MANUFACTURER'S FIELD SERVICE

3.3.1 Service Personnel

The UPS manufacturer shall utilize a Nationwide 3rd party and/ or directly employed service organizations, consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment.
The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours a day, 7 days a week and 365 days a year. If emergency service is required, on-site response time shall be 4 hours or less within 150 miles of a Fuji Electric authorized service center.

3.3.2 Replacement Parts Stocking

Parts shall be available through an extensive network to ensure round-the-clock parts availability throughout the country.
Spare parts shall be stocked by local field service personnel with backup available from national parts centers and the manufacturing location. A Customer Support Parts Coordinator shall be on call 24 hours a day, 7 days a week, and 365 days a year for immediate parts availability.

3.3.3 Maintenance Contracts

A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system shall be available.