SolarEdge Critical Power

Three Phase Modular UPS for 480 Vac Grid

B240US

30 kVA/kW – 960 kVA/kW

Master Specification

V6

Table of Contents

I. GENERAL

1. Introduction

XXX, ("Principal") shall provide an Uninterruptible Power Supply (UPS) solution to back up the critical and sensitive load in YYY's (Name of the Site) site.

2. General Requirements

This document covers the requirements for the delivery to site, installation, commissioning and maintenance of the latest state-of-the-art modular Uninterruptible Power Supply (UPS) systems as described in Table 1. The UPS system shall be a scalable solution capable of supporting modular (vertical) and parallel (horizontal) redundancy.

Electrical configuration / topology of the UPS unit shall be double-conversion, shall include bypass, and shall have zero transfer time between normal mode (inverter mode) and battery mode, as described by IEC 62040-3, Annex A.

TABLE 1

No.	UPS Capacity Quantity	Backup (min)
1	XX_1 kW	$\#\#_1$
N	XX_N kW	$\#\#_N$

2.1 Compliance: The offer must comply with requirements presented in this tender. Deviations must be indicated in the offer documentation; otherwise the requirements will be considered fully covered by the standard equipment.

3. General Vendor Requirements

3.1 The manufacturer shall have over 40 years experience in power conversion and UPS production.

3.2 The Principal shall have a proven track record with existing installations of the modular UPS system successfully undertaken by the Principal themselves.

3.3 The Principal shall have factory-trained technicians at local service centers to provide support for the UPS.

3.4 The Principal shall have sufficient UPS spare parts stocked at the nearest authorized service center or its branches, to provide fast and efficient after-sales service.

3.5 The Principal shall keep spare parts in stock for at least 7 years from the date that the UPS is removed from production.

3.6 The Principal shall have all the required tools, testing and measuring equipment needed to provide professional service and support for the UPS during installation and throughout the warranty period.

3.7 The Principal's engineers and authorized service centers shall support the installation and maintenance of the UPS system.

3.8 The Principal shall provide relevant technical data, including the dimensions and weight of the UPS.

4. Standards

The UPS shall comply with the following national and international standards:

4.1 Safety per UL 1778 and CSA C22.2 No. 107.3-05

4.2 Electromagnetic compatibility (EMC) per FCC Part 15B Class A

4.3 IEC 62040-3: Method of specifying the performance and test requirements

4.4 UPS classification as VFI – SS – 111, which means that:

4.4.1 The UPS's output voltage and frequency are independent from the input;

4.4.2 The UPS has steady-state sinusoid output waveform; whether the UPS is operating in normal mode, bypass mode, or battery mode.

4.4.3 The UPS's dynamic output performance is suitable for sensitive critical loads.

5. Quality and Reliability

5.1 UPS supplier is certified to ISO 9001:2015.

5.2 In order to ensure high quality and reliability of the UPS:

5.2.1 The UPS will be manufactured under recognized international standards of quality assurance practiced, such as ISO 9001, IPC 610 and IPC 620.

5.2.2 Components and items of the UPS will be purchased only from approved suppliers.

5.2.3 All sub-contractors will be certified to ISO 9001 standard or equivalent

5.2.4 Each UPS will be supplied after successful completion of in-house comprehensive acceptance testing.

II. PRODUCT

6. General Specifications

6.1 Topology

The UPS system shall be designed to supply a consistent, regulated and stable AC output power waveform to critical loads, 24 hours a day and 365 days a year, regardless of utility supply voltage and frequency variations, transient peaks, and short or long power cuts, within the limits of the scope of supply specified.

The UPS shall have true sinusoid output waveform and double-conversion VFI (Voltage and Frequency Independent) topology.

The system shall consist of ac power modules ("ACPM") and battery converter modules (BCM). The ACPMs perform double conversion of power from ac to dc and back to ac while charging the battery via the BCMs. The BCMs boost the battery voltage to that required by the ACPM's inverter function during mains failure or malfunction of the ACPM's rectifiers. The dc is required by the ACPM's inverter function during mains failure or malfunction of the ACPM's rectifiers.

6.2 Modularity and Scalability

6.2.1 Maintenance of the UPS shall be carried out live without any interruption to a customer's critical load. To achieve this, the ACPMs and BCMs shall be hot swappable at any time subject to connected load levels, without having to switch the UPS to maintenance bypass mode.

6.2.2 Each ACPM shall contain its own built-in controller, rectifier and inverter. Each BCM shall contain its own built-in controller and dc/dc converter.

6.2.3 Each ACPM and BCM shall be able to operate independently, without any need for an external controller.

6.2.4 The ACPMs and BCMs shall be hot-swappable (i.e., replaceable during normal system operation) with no impact on the load.

6.2.5 The ACPMs shall not be restricted to any specific location among the ACPM-dedicated shelves of the UPS frame. The BCMs shall not be restricted to any specific location among the BCM-dedicated shelves of the UPS frame. The ACPMs and BCMs can be install`led without pre-configuration. Configuration shall be entirely automated.

6.2.6 The system shall have only one main controller, which shall be fail-safe. In the event that the controller fails or is removed for maintenance, the system shall continue to supply power to the load without interruption. In such a case there shall be no need to put the system in maintenance bypass mode to continue full support of the connected loads.

6.2.7 When individual power modules are hot-swapped, the system load shall be shared equally among all remaining modules. This process shall be done in zero time and without disturbance to the connected load.

6.2.8 The UPS system shall be scalable to a higher capacity by simply adding ACPMs and BCMs, up to the UPS frame design maximum capacity. The addition of the ACPMs and BCMs shall be "hot- swap", i.e., they can be added to the system live without disruption to the critical loads. Similarly, the UPS system can be downsized by simply removing ACPMs. ACPMs and BCMs shall be interchangeable within B240US system models. It is the responsibility of the

UPS operator to be certain to have enough ACPMs and BCMs to support the level of connected load.

6.2.9 The UPS shall support module redundancy; that is, the use of one or more modules greater than that needed to handle the UPS's expected maximum load. These redundant modules shall act as hot standby units to eliminate the need for "around-the-clock" emergency services. Under normal conditions all the installed modules share the total load.

6.3 Modes of Operation

The UPS shall be designed to operate using one or more ACPMs in the following modes:

6.3.1 Normal Mode: The ac mains supply shall be rectified by high frequency IGBT rectifier into regulated dc voltage for powering the dc/ac inverter while charging the batteries. The dc/ac inverter shall be PWM 3 levels IGBT and the output voltage shall have a true sinusoid waveform.

6.3.2 Mains Failure Mode: In the event of a mains voltage deviation outside the specified input parameters of the UPS, in zero transfer time, the batteries shall provide power to the loads, without any disruption. The batteries supply voltage to the dc/ac inverters located in each of the ACPMs.

6.3.3 Battery Power Mode: In the event of a mains power failure, the UPS shall support the load on battery power. When the ac mains return to normal, the UPS shall resume normal mode and shall continue to provide quality output to the load without disturbance, while simultaneously recharging the battery. The battery bank shall provide the backup time stated in the tender specification.

6.3.4 Recharge Mode: When the ac mains power is restored, the UPS shall automatically resume recharging the batteries after a short, user programmable, power walk-in period. This charging shall cause no interference or disruption to the critical load.

6.3.5 Bypass Mode: The UPS system will automatically transfer to bypass in the event of an internal failure or extended overload that results in the UPS not being able to support the connected loads. Bypass mode can also be manually initiated from the system controller.

6.3.6 Generator Mode: When the ac mains power supply is replaced by a generator, the UPS shall automatically resume working in normal mode. The system enables you to select optional battery charging and/or frequency tracking (free-running mode) when in generator mode. Frequency range in free running mode is 40-70Hz.

6.3.7 Self-Loading Mode: The self-loading feature shall enable the system to test itself for both reactive and resistant simulated loads eliminating the need for external load banks.

6.3.8 ECO Mode: The system shall run at up to 99% efficiency with the inverters on standby. In case of anomalies in the mains, the system shall automatically transfer the load to the inverter to back up and ensure its continuous regulated ac power.

6.4 Maintainability

Easy maintainability of the UPS system shall be regarded as an important feature in the design, which shall embody safety and simplicity.

6.4.1 It shall be possible to perform basic maintenance on the UPS at any time without the need to shut down the UPS or isolate the batteries. During maintenance the UPS shall be able to provide full protection to the load without any disruption, using the N+1 configuration.

6.4.2 The ACPMs and BCMs shall be easily accessible from the front of the UPS, and can be removed while the system is still running. No special equipment is required for the removal of modules. The modules are removable by unscrewing and sliding them out of their respective slots.

6.4.3 After inspection and cleaning, the modules shall be easily reinserted into the system without having to carry out any manual phase synchronization.

6.4.4 The manufacturer shall continue to support the system for at least five years following the date on which the UPS is removed from production.

6.4.5 The Principal shall demonstrate that the removal and replacement time of the ACPM or BCM shall take less than 15 minutes by either trained or untrained staff.

7. System Specifications and Requirements

7.1 System Structure and Architecture

7.1.1 The system shall consist of up to eight ACPMs, each with an output capacity of 30 kVA/kW, for a system total of 240 kVA/kW.
The system shall also include up to four BCM's, each with an output capacity of 60 kVA/kW, for a system total of 240kVA/kW respectively.

7.1.2 The system shall contain one centralized electronic static switch, rated for 240 kVA/kW, which is a removable static switch

7.1.3 The system’s controller shall be fail-safe, and the system shall be operable without the system controller or in the event that the monitor display is inhibited. The UPS will function in its capacity once the controller is removed;

only monitoring and manual changes will be non-operational during system controller replacement.

7.1.4 Battery protection

7.1.4.1 Low Voltage Detection (LVD): The LVD function in the system shall be designed to disconnect the battery after the end of battery backup to protect against deep discharge of the batteries. After a pre-selected time delay, the trip coil will be triggered so as to disconnect the batteries from the system thereby protecting the batteries.

7.2 Environmental Conditions and Thermal Design

7.2.1 Airflow from the front side to the back side of the UPS shall be unrestricted up to 251.6 CFM per module at a load above 50%.

7.2.2 Cooling shall be by forced air, with microprocessor-controlled fan speeds. Fans operate according to the respective module parts. That is, as different parts of the module functions, their respective fans operate to allow for active cooling.

7.2.3 The UPS shall not require additional forced cooling.

7.2.4 The module includes built-in thermal protection.

7.2.5 The UPS system shall operate satisfactorily under the following ambient and environmental conditions:

7.2.5.1 Operating temperature: +14 °F to +104 °F (-10 °C to +40 °C)

7.2.5.2 UPS Storage temperature: -4 °F to +140 °F (-20 °C to +60 °C)

7.2.5.3 Storage with batteries: +32 °F to +68 °F (0 °C to +20 °C)

7.2.5.4 Relative humidity: 0 to 95 % maximum without condensation.

7.2.5.5 Altitude: from sea level to 4921 ft (1500 m) without derating.

7.2.6 UPS enclosure protection level: IP20.

7.2.7 Seismic brackets shall be included.

7.3 System Efficiency

7.3.1 Ac-ac efficiency without batteries connected can reach up to 96.8 %.

7.3.2 Physical limitation: due to limited space the UPS shall satisfy the following dimensions:

7.3.2.1 UPS system footprint shall be no greater than 24 (W) x 41 (D) inches, or 61 (W) x 105 (D) cm.

7.3.2.2 UPS system heights shall be maximum 80 inches or 203 cm.

7.3.2.3 UPS system weight shall not be more than 881 lbs (400 kg) for a 240 kW system.

8. AC Power Module (ACPM) Specification and Requirements

8.1 Rectifier

8.1.1 The rectifier shall be rated to provide full load current to the inverter, while simultaneously providing the required current to charge the battery.

8.1.2 In the event of failure, the rectifier and its associated components in the ACPM shall automatically shut itself down. This feature helps isolate the failure area and prevent the problem from spreading to the rest of the UPS, preventing a shutdown of the entire UPS system.

8.1.3 The ACPM's rectifier shall be designed to operate with the following input characteristics:

8.1.3.1 Input Voltage: 3 x 480 Vac between 408 to 552 Vac without derating, 3 wires + Gnd and linear derating down to 50 % capacity.

8.1.3.2 Frequency Tracking: 50/60 Hz, selectable ±(0.5, 1, 2, 3, 4) Hz

8.1.3.3 A power walk-in: <60 sec, selectable

8.1.3.4 Input Power Factor: >0.99

8.1.3.5 Surge and Fast Transients Immunity Complies with:

8.1.3.5.1 UL1449 3rd Class II/C based on the ANSI/IEEE Regulations

8.1.3.5.2 UL1449 4th Class II/C based on the ANSI/IEEE Regulations

8.1.3.6 Input current: 3 x 38 A protected per power module per phase; no inrush current at startup.

8.1.3.7 THDi up to 3 %

8.2 Inverter

8.2.1 The inverter output of all the ACPMs shall be phase synchronized without any need for an external controller within the selectable tolerance range.

8.2.2 Inverter failure in a particular ACPM shall not affect the entire system. The faulty module will shut down and isolate itself to allow all the remaining modules in the UPS system to continue to provide output ac power without interruption to the critical load.

8.2.3 The inverter shall be able to restart automatically upon the availability of a power source, within the LVD time delay, even after a prolonged power failure that caused the battery to discharge to the minimum working voltage. Automatic restart shall be selectable according to user preferences.

8.2.4 The module's inverter shall continuously provide high-quality output power to the load with the following characteristics:

8.2.4.1 Output voltage: 3 x 480 Vac, 3 wires + Gnd, with ±1 % range

8.2.4.2 Frequency: 50 or 60 Hz ± 0.1 %, selectable

8.2.4.3 Output Frequency: synchronized to the ac power line, 46~54 Hz, or 56~64 Hz configurable

8.2.4.4 Output Power Factor: 0.99 load dependent

8.2.4.5 Dynamic Voltage Response to 100% load step: ±2 %

8.2.4.6 Output Voltage Total Harmonic Voltage Distortion (THDv)

For linear load: up to 2 %

8.2.4.7 Inverter current limit: 36 A /module

8.2.5 The self-loading feature shall enable the system to test itself for both reactive and resistant simulated loads eliminating the need for external load banks.

8.3 Physical Size and Weight

8.3.1 Each ACPM shall weigh no more than 44 lbs (20 kg), and shall be no more than 2U in height to allow replacement by one person in compliance with OSHA rules.

8.4 AC Power Module LED Indicators

8.4.1 Input: Green LED = OK; Red LED = Fault; Orange = Standby

8.4.2 Output: Green LED = OK; Red LED = Fault; Orange = Standby

9. Battery Converter Module (BCM) Specification and Requirements

Bidirectional dc to dc converter converts the rectifier output dc voltage to the required floating voltage which keeps the batteries fully charged. Upon mains failure or rectifier malfunction the BCMs boost the battery voltage to the required ACPM's inverter input voltage

9.1 Battery Charging Converter Stage (Charging Mode):

9.1.1 The BCM shall convert the ACPM dc voltage to the required floating dc voltage and provide up to a 20 A charging current.

9.1.2 The BCM shall have built-in protection to eliminate the possibility of overcharging the battery.

9.1.3 The battery charging current limit shall be configurable up to 20 A per BCM.

9.1.4 The BCM's charging voltage shall be configurable to allow use different types of batteries and adjust battery quantities during service.

9.2 Battery Boost Converter Stage (Battery Mode):

9.2.1 Upon mains failure or rectifier malfunction the BCM, shall immediately change the direction of its power flow from charging mode to battery boost mode, keeping the ACPM's inverter within operational range, so that it keeps the load running without interruption.

9.2.2 The BCMs in the system shall operate in parallel and equally current share the battery discharge current.

9.2.3 The BCM's converter shall continuously provide high-quality output power to the ACPM with conversion efficiency (dc-dc) of up to 98 %.

9.3 Physical Size

9.3.1 Each BCM shall weigh no more than 44 lbs (20 kg), and shall be no more than 2U in height to allow replacement by one person in compliance with OSHA rules.

9.4 Battery Converter Module Indicators

9.4.1 Module fault indicator red LED.

9.4.2 Input OK, green LED (charging).

9.4.3 Output OK, orange LED (discharging).

10. System Controller Specification and Requirements

10.1 Control, Indication and Alarm

The UPS system includes the following control, indication and alarm system:

10.1.1 Local Control Panel 7" color, touch LCD power flow diagram indications.

10.1.1.1 Ac line status and measurements

10.1.1.1.1 Input voltage current power factor

10.1.1.1.2 Active/reactive power

10.1.1.1.3 Frequencies

10.1.1.2 Bypass line status and measurements

10.1.1.2.1 Input voltage current power factor

10.1.1.2.2 Active/reactive power

10.1.1.2.3 Frequencies

10.1.1.3 Inverter line status and measurements

10.1.1.3.1 Output voltage current power factor

10.1.1.3.2 Active/reactive power

10.1.1.3.3 Frequencies

10.1.1.3.4 Output sine wave distortion

10.1.1.4 Output line status and measurements

10.1.1.4.1 Output voltage current power factor

10.1.1.4.2 Active/reactive power

10.1.1.4.3 Frequencies

10.1.1.4.4 Output sine wave distortion

10.1.1.5 Battery and battery test status

10.1.1.6 Load on bypass

10.1.1.7 Load on inverter

10.1.1.8 Load level

10.1.1.9 Normal mode

10.1.1.10 Battery mode

10.1.1.11 Communication status with modules and static switch

10.1.1.12 Synchronization status

10.1.1.13 UPS ON

10.1.1.14 The local LCD indicator shall be located on the system cabinet. The following information shall be available on the LCD panel:

10.1.1.14.1 System output power bar graph showing output load percentage

10.1.1.14.2 System ac input and output voltages

10.1.1.14.3 System input and output current

10.1.1.14.4 System ac input and output frequency

10.1.1.14.5 System power factor (PF)

10.1.1.14.6 Input and output voltages and currents for per module

10.1.1.14.7 UPS total capacity

10.1.1.14.8 Dc voltage levels

10.1.1.14.9 Power module status

10.1.1.14.10 Event log, with scope readings

10.1.1.14.11 Static switch status

10.1.1.14.12 Additional monitoring and control information

10.2 Event Log

10.2.1 The system controller shall have an oscilloscope measurement reading of each event in the log. The oscilloscope capture displays a 100 ms window of the event. The scope reading is composed of 50 ms prior to the event, the event itself and 50 ms after the event. The oscilloscope readings shall include:

10.2.1.1 Three phase input bypass voltages showing amplitude and frequency

10.2.1.2 Three phase output voltages showing amplitude and frequency

10.2.1.3 Positive, negative and midpoint dc voltages showing amplitude

10.2.1.4 Three phase output currents

10.2.1.5 Reference sine wave

10.2.2 The UPS shall be able to record the most recent 2000 system events, including system start-ups, system shut downs, and alarm conditions.

10.2.3 For each event the log system shall capture all system measurements, modules input, output and dc voltages, static switch's inverter, bypass and output voltages, status of each ACPM and BCM, etc.

10.3 Web Interface

The system shall include a browser-based Inter/Intranet interface enabling the user to monitor the UPS remotely and shall have the following monitoring capabilities:

10.3.1 UPS input parameters: voltage, frequency

10.3.2 UPS output parameters: voltage, frequency, load current

10.3.3 UPS battery status

10.3.4 Events log and fault alarm indication

10.3.5 Status and parameters of each ACPM and BCM

10.4 Communication

The UPS shall include the following communication features:

10.4.1 Support for SNMP - RFC1628 as standard.

10.4.2 TCP/IP MODBUS

10.4.3 HTTP server allows remote monitoring only

10.4.4 Support for RS232 – SEC protocol as standard

10.4.5 Support for RS485 with no need for additional adaptor

10.4.6 Email notifications of alarms as standard – unlimited recipients

10.4.7 Automatic orderly shutdown of an unlimited number of servers during mains failure

10.4.8 Dry contacts, seven configurable input dry contacts and seven configurable output dry contacts

10.4.9 One of the input dry contacts should be configurable to activate generator mode

10.4.10 SNMP allows remote monitoring. Management shall be allowed from system controller only.

10.4.11 Modbus (serial and TCP/IP) allows remote monitoring only

10.4.12 SNMP supports mail for alarm notifications

10.4.13 Serial SEC protocol for UPS - allows both monitoring and management

11. Static Switch Specification and Requirements

11.1 Electronic fast-acting static switch

11.2 Microprocessor logic command and control which will:

11.2.1 Automatically transfer the load to the mains, as soon as the following anomalous events occur: overload, over temperature, voltage runaway on the dc buses, anomalies on the inverter

11.2.2 Automatically transfer back the load from the mains to the inverter as soon the anomalous event expires

11.2.3 Regulation of forced-air cooling and over-temperature protection

11.3 Built in back feed protection in accordance to UL 1778

11.4 The system shall provide ECO mode for increased efficiency.

12. Battery and Backup Time

12.1 The battery backup time shall be according to Table 1 and the tender shall clearly indicate the voltage and Ah rating of the battery.

12.2 The batteries shall be rechargeable, valve regulated, sealed, lead-acid type, and the construction shall be such that no maintenance is required during operation.

12.3 User selectable batteries

12.4 The batteries shall be able to withstand rapid charging without damage and shall be able to provide at least 10 minutes of battery backup.

13. Operating Multiple Units in a Parallel Configuration

13.1 The unit should be able to be connected in parallel with up to three additional units (for a total of four units) without any need for special parts other than parallel communication cables, which connect the parallel UPSs together in a ring configuration.

13.2 In the event that one parallel unit is faulty, the load shall be distributed among the remaining units and there shall not be a need to switch over to mains or generator supply as long as they can support the load.

13.2.1 The parallel architecture shall allow a faulty ACPM to isolate itself. The load that it supported shall automatically be distributed among the remaining ACPMs and shall be shared equally among them. The parallel systems shall continue to operate normally with no disruption to the load as long as they can support the load.

13.2.2 The parallel architecture shall allow a unit, ACPM or BCM to be isolated for maintenance without disruption to the load and without transfer of the load to internal or maintenance bypass as long as the remaining unit(s) or ACPM(s) can support the load.

13.3 Each ACPM has an output capacity of 30kVA/kW. The system shall hold one up to 8 ACPMs. The current sharing between the paralleled units shall be on the ACPM level across all of the UPSs. However, each UPS unit requires its own battery bank(s).

III. EXECUTION

14. Installation and Commissioning

14.1 Preparation of the installation site:

The purchaser shall prepare all infrastructure needed to allow for the UPS installation and operation to be according to the manufacturer instructions. The manufacturer shall provide an installation guide and all installations must meet local codes.

14.2 Pre-Installation

Prior to installation of the UPS system:

14.2.1 The Principal and the purchaser shall carry out a joint onsite inspection of all equipment and infrastructure. Defective components shall be replaced at no additional cost to the purchaser.

14.2.2 Installation plans, schedule and list of personnel (complete with credentials) shall also be submitted.

14.3 Installation

The electrical contractor representative shall follow the manufacturer's installation guidelines and meet local codes.

14.4 Commissioning

14.4.1 Site Acceptance Test (SAT)

14.4.1.1 Upon completion of all installation works, a final test shall be conducted and shall include performance and function tests.

14.4.2 The UPS testing shall be in accordance to IEC 62040-3, for mains failure, mains return, transfer, backup time and battery recharge. The SAT is described in details in the installation manual

14.4.3 The Principal shall prepare a testing schedule for the mentioned tests and shall submit it to the purchaser for approval.

15. Product Warranty

15.1 Products shall be covered under the manufacturer's Limited Warranty.

16. Manuals

Each UPS system has the following guides:

16.1 User guide

16.2 Installation guide; including connection diagrams, terminals and current ratings

17. Familiarization Training

17.1 Familiarization training will take place during or following the system acceptance test (as appropriate to the situation). The training shall include the following elements:

17.1.1 UPS system structure

17.1.2 UPS system operation

17.2 Training shall take 1-4 hours depending on the system complexity (e.g. single or parallel system)

17.3 Certificate of attendance will be provided upon training completion

18. System Hand-over and Acceptance

Hand-over and acceptance of the system shall occur after system installation has been completed, and shall include:

18.1 Endorsement of defect list

18.2 Endorsement of test results

18.3 Certificate of acceptance

(End.)