Tender Technical Specification

For Three phase UPS, on line double conversion (VFI)

80 kVA - 72 kW

Index

1 GENERAL REQUIREMENTS

1.1 Subject and agreement type

Whit this tender it is asking the best offer to supply Nr. XX three phase UPS with following technical specifications:

- Nominal Power: 80.000 VA – 72.000 W– Power Factor (cosφ): 0,9;
- Topology: On Line Double Conversion VFI;
- Technology: Hi frequency PWM;
- Passing trough Neutral;
- Modular Architecture based on 6700VA Power Modules;
- Possibility to configure the system in N+X internal redundancy in the inverter cabinet;
- Possibility to remove and replace power and battery modules without switch the load on bypass
- Equipped with batteries type: lead acid, sealed, free maintenance, VRLA, installed into the system or in a dedicated external battery cabinets. Batteries must guarantee a minimum back up time of xx **minutes** at 80% of the applied load with specific characteristics described in Technical Specs Table.

1.2 Conditions

The offer must comply with requirements presented in this tender, specifying eventual deviations.
Deviations must be indicated in the offer documentation; on contrary the requirements will be considered full covered by offered equipment.

2 GENERALI SPECIFICATIONS

2.1 On Line Double Conversion VFI

The Topology of the UPS must be VFI (Voltage and Frequency Independent accordingly with classification mentioned in the EN- IEC62040-3 Standard), in order to guarantee filtered and stable output voltage to the load, independently from the input voltage. This means that the output is obtained by two converters in cascade. The first converter rectifies the AC input voltage, the second converter (Inverter) transforms the DC voltage, coming from the rectifier, in AC voltage to supply the load.
This double conversion allows to completely clean eventual disturbs from the mains.
In case of anomalies in the input voltage, the DC voltage, which supply the Inverter, can be obtained , thought a booster circuit, from batteries. In this way the output is always guaranteed with continuity.
In case of overloads or faults, the automatic static by-pass guarantees the load supply.

2.2 Modularity

The UPS must have modular architectures based on identical power modules which can be interchanged and connected in parallel, inside the UPS cabinet.
Similarly also batteries must be contained in battery modules (Battery drawers) identical and interchangeable, to be installed in the system in series and parallel in order to obtain the correct battery voltage and required back up time.
It will be not accepted a system where one or more modules are kept in stand by just as spare to be used only in case of another module failure.
Power modules will be equipped with control and self diagnostic circuits, in order to easily individuate the faulty module and the specific failure inside it.
Each Battery drawer will contain 7 batteries with nominal 12Vdc, connected in order to have two strings, one with 48Vdc (four batteries) and the other one with 36Vdc (three batteries).
In this when battery drawer is removed from the cabinet there are no dangerous voltage for the user (dangerous DC voltage are bigger than 50V as indicated in the EN60950 standard).
Either Power Modules and Battery drawers must be lighter than 18kg in order to be managed, in service and maintenance, by only one person.

2.3 Redundancy N+X

The UPS must be configurable as N+X power redundant system, with modules of 6700VA contained in same cabinet either for single phase than for three phase run.

This kind of redundancy must guarantee continuous supply and protection whenever one module fails. Redundancy must be obtained through the load sharing technology as explained in paragraph 2.5.

2.4 Scalabilty

The modularity of the UPS must allow to increase the back-up time on site, simply adding battery drawers. The upgrade will not require factory modifications and will not need dedicated special tools.

2.5 Architetture

The architecture of the UPS must be **parallel distributed**, to be more precise, the load will be shared between all power modules in each phase. In this way, during normal run, no power module is inactive or in standby. In a redundant configuration, if one moduel fails all the others ones will take the relevant load without any interruptions or transfer time at the output of the UPS. In case one module failure the power is guaranteed by the others modules and the supplied power will been s follows:

$$P_{out} = P_{nom} \frac{(n-x)}{n}$$ in single phase configuration

and

$$P_{out} = P_{nom} \frac{(n-3x)}{n}$$ in three phase configuration

where

- P_{nom} is the nominal power of the UPS;
- P_{out} is the power supplied by the UPS with one module out of order;
- n is the number of installed power modules inside the UPS;
- x is the number of power modules out of order;

3 DESCRIPTION OF THE SYSTEM

3.1 POWER MODULE

Each Power Module will be composed by following functional blocs:

- *Inverter*
- *Booster*
- *Battery Charger*
- *Rectifier/PFC*

- *Automatic Bypass*

3.1.1 Rectifier/PFC

The rectifier must include a control and regulating circuit (PFC), which in addition to normal rectifying functions will allow the:

- Automatic correction of the power factor to the at value >0,99 (since from the 50% of the nominal load);
- Reduce the Harmonic distortion of the input current obtaining $THDI_{in}$ = 3% with nominal load

3.1.2 Inverter

The inverter must be based on a switching IGBT circuit with High Frequency PWM, and must be able to transform the DC supply, coming from rectifier/PFC or buster, in case of battery run, in AC voltage.
Furthermore must be present also control circuits which guarantee:

- Arrest and protection of the inverter in case of strong and long overloads;
- Keep the harmonic distortion of the output voltage les than 1% ($THDu_{out}$ < 1%) either in normal run than in battery run;
- Arrest and protect the inverter in case of over temperature of power converters elements;
- Manage the speed of the Fans accordingly with internal temperature and applied load;

3.1.3 Booster

The "booster" must transform the battery DC voltage from the nominal value of 240 Vdc, to the dual, positive and negative buses, with middle point referred to the passing trought neutral. From the positive bus the inverter will obtain the positive half period of the output voltage sine wave, from the negative bus the inverter will obtain the negative half period of the output voltage sine wave.
Protection circuits must be present on the booster to protect the booster circuit in case of stron overload.

3.1.4 Battery Charger

The Battery Charger must be equipped with control and regulation circuit both for charging voltage and current to batteries, in order to have a controller battery charge and optimize the battery life.
The UPS must charge batteries with and early boost charge followed by a constant charge and, at the end, with a floating charge. During normal run the UPS will execute periodically a battery equalizeing in order to recover natural charge leakages and keep al batteries at the same capacity. This battery charging cycle will increase the batteries life time over the aspected five years, with relevant reduction of the maintenance costs.
The battery recharge must be available also when UPS is turned off.

3.1.5 Automatic Bypass

The Automatic bypass must be composed by following parts:

- Static switch with zero time for intervention, connected in parallel with an electro-mechanic switch which needs a trannsfer time but with zero heat dissipation amog the time;
- Microprocessor Logic comand and controll which will attend to:
  - Automatically transfer the load to the mains, as soon as following anomalous events occur: overload, overtemperature, voltage runaway on the DC buses, anomalties on the inverter;
  - Automatically transfer back the load from the mains to the inverter as soon the anomalous event expires;
  - Automatically disable the bypass function in case of output voltage and Mains are not synchronized.

3.2 COMMAND BOARD

The Command board must be equiped with microprocessor of suitable computation power. This command board must manage all functions of the UPS and will execute the following jobs:

1. automatic recognition of the number of connected modules;
2. automatic setting of the maximum reactive power that can be provided on the output;
3. individual serial communication with the power modules by a dedicated line;
4. recognition of a faulty module and diagnosis of the relevant fault;
5. synchronization of the output voltage with the input voltage;
6. generation of a reference sinewave curve to form the output voltage wave;
7. control of the PFC, inverter and booster circuits in each power module;
8. management of the automatic bypass;
9. management of the battery runtime (see relative section);
10. management and recognition of the signals and measurements from each module;
11. management of the user interface (see relative section);
12. management and memorizing of UPS history parameters and data;
13. alarm and events memory with association of the time and date of the events themselves.

3.3 Batteries

3.3.1 Battery type

The hermetic, maintenance-free stationary lead batteries are housed in the UPS and/or in one of more cabinets of the same shape and size as that of the UPS itself. The positive and negative battery connections are protected by an adequate fuse-holder isolating switch.

3.3.2 Battery Module (Drawer)

The complete set of batteries consists of at least 21 units so as to obtain an overall 240 V nominal voltage (direct voltage).
A drawer comprises five 12 V 9 Ah batteries connected in series. The drawer must complies with CEI-EN 60950 standards governing electrical safety, which requires the use of adequate protections and particular care when dangerous voltages higher than 50 Vdc are present and direct contacts are possible.
The runtime can be increased to a further extent by adding more battery drawers in multiples of four, using both the housings in the UPS and those pre-engineered in the additional "modular cabinets".

3.3.1 Battery management

The following functions must be available:

Conduction of the battery test either automatically or upon the user's request.
Battery efficiency test conducted by making an automatic full discharge at programmed or periodic frequencies, as required by the user. The battery is discharged by use of an appropriate algorithm with discharge curve control so as to monitor the performance and status of the batteries.
Calculation of the residue battery runtime during the discharge phase, depending on the load applied.

To protect the batteries from damage due to deep discharges1 the minimum tolerated battery voltage limit2 is automatically changed to suit the applied load (default setting), while allowing the user to select a type of management with fixed voltage limits.

The "average battery life is 4-6 years.

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[1] prolonged discharges with a low load
2 voltage that causes the inverter to switch off owing to end of runtime

3.4 Digital Display e Alarm signal

UPS will be equipped with a backlighted alphanumerical liquid crystal display (LCD), with 20 characters on 4 lines. This display is built into the front part of the UPS where there is also an ultra-bright operating status indicator which shows the operating status and any alarm conditions by means of a traffic light code.

Four simple buttons situated near the display allow the user to:
- display the operating data (ref. sect 2.2 Measurements)
- enter the operating parameters (ref. sect. 2.3 Adjustments);
- select the language in which the messages are given.

4 OPERATING PRINCIPLE

The purpose of this section is to define the various different operating conditions of the UPS.

4.1 Normal service condition

In normal conditions, UPS runs in the double conversion on-line mode, thus the users are powered in an uninterrupted way by the inverter, which is powered by the electricity main through the AC/DC converter (rectifier/PFC) that automatically corrects the power factor on the UPS input as well.
The inverter is constantly synchronized with the electricity main so as to allow the bypass to function correctly during mains/inverter and inverter/mains commutations. These commutations may be necessary if an overload occurs or if the inverter stops.
The battery charger in each power module provides the power required to keep the battery charge at an optimum level.

4.2 Inverter stopping or overload

4.2.1 Inverter stopping

If the inverter stops, the user is automatically transferred without interruptions to the primary main by means of the automatic bypass.

4.2.2 Overload

When a temporary overload occurs on the load side of the UPS, current monitoring allows the UPS to withstand the situation within certain limits, without the automatic bypass having to be used: if the overload lasts a long time or exceeds the limits preset by the current monitoring device, the user is transferred without interruptions to the primary main by means of the automatic bypass and then returns to the inverter once the overload has terminated.

4.2.3 Bypass activation sensitivity adjustment

Bypass activation, based on the length of time "loss of voltage" on the output lasts, can be regulated by the user in discrete steps so as to facilitate use of UPS together with equipment characterized by frequent surge currents. This adjustment can be carried out by the user from the front panel or by means of the diagnostic software installed on an external PC.

4.2.4 Inverter stopping in a Power Module

The modular architecture, with N+X redundant configuration, allows energy to be supplied to the load even if the inverter of a power module stops.

The nominal power represented by the sum of the functional modules can always be supplied to the user, which can work at reduced load or full load in the case of a redundant configuration. The inverter stopped condition is detected by the monitoring logic, is transmitted to the microprocessor and is then signaled to the user on the frontal display or via software. Each power module also has a LED that immediately signals its operating status. This allows the damaged module to be immediately identified and facilitates the replacement operations.

4.3 Emergency condition (Mains failure)

In a blackout, or if the electricity main values are off range, the users are powered by the batteries via the booster-inverter pathway. The batteries function in discharged conditions in this operating mode.
The UPS informs the user about this operating status with clear visual and acoustic signals.
Thanks to a diagnostic-predictive algorithm, the microprocessor control can calculate the available residual runtime depending on the instantaneously applied load. This runtime is shown on the frontal display of the unit with a reasonable degree of accuracy.

4.4 After a blackout

When the electricity Mains power returns within the tolerated limits after a voltage drop or a blackout, the UPS automatically returns to operate in normal service conditions absorbing electricity from the Main.
Even after the end of autonomy, at the return of the Mains the battery charger automatically start to charge batteries.

4.5 Smart Eco Mode

In order to save Energy in particular conditions the UPS must be easily set by the user to run in Eco Mode. In this running mode the load is directly connected to the utility. In the mean time the UPS is continuously checking the mains Energy supply, as soon the input Energy is out of tolerance, the UPS immediately switches in on line mode.

4.6 Maintenance Bypass

The UPS will be equipped with a manual maintenance bypass to allow the service and the access to modules and battery, keeping the load powered. The maintenance bypass can activated manually and must be protected by a door locked with a key.
A disconnectors system must isolate the internal parts of the UPS from any energy source allowing the UPS maintenance, service and acces to modules without danger.

4.7 Hot Plug – Hot Swap

In redundant configurations the UPS must be able to supply and protect the load, also during the replacement of faulty module and no bypass switch is needed.
In case of scalable configurations (empty power module slots in the cabinet), it must be possible to install additional modules during normal run without switch the load on bypass and execute software settings.

4.8 Operation with a genset or as a frequency converter

The output frequency of UPS is synchronized with the mains input frequency. This synchronizing process is guaranteed by the microprocessor control within a ±2% range of the nominal frequency (50 Hz or 60 Hz).
Out of this range, the UPS stops the synchronizing with the input frequency and guarantees a strictly constant output frequency. (in this particular condition of asynchrony between the input and output, it is absolutely essential for the automatic bypass to be disabled).

4.8.1 Genset

To achieve optimum operation in combination with generators or gensets, typically characterized by frequency fluctuations exceeding the ±2% range, the UPS must have the possibility to guarantee

synchronism between the input and output frequency for even wider frequency ranges, not less than ±14%
Normally, when the UPS runs in synchronsm, the automatic bypass must be enabled.

4.8.2 Frequency converter

UPS can also works as a frequency converter, i.e. by working with a different input and output frequency without any type of synchronism. In other words:
50 Hz input - 60 Hz output;
60 Hz input - 50 Hz output.

4.8.3 Asynchronous operation

As a consequence of characteristics 1.5.1 and 1.5.3, with the appropriate settings, the UPS can run in asynchronous conditions generating to the output a constant frequency, within a maximum ±1% range whenever the input frequency is variable.
This operating mode allows the UPS to work with imput Mains supply with extremely variable frequencies, guaranteeing a constant output frequency at both 50 Hz and 60 Hz.

4.9 Data availability when UPS is Off

The UPS will allow the possibility to make settings, data readings and diagnostic checks also when it is turned off, activating the display in a temporary service mode.

5 Control Panel and Display

UPS must be controlled by a microprocessor and must be equipped with a backlit alphanumerical liquid crystal display (LCD), with 20 characters on 4 lines. This display is built into the front part of the UPS where there is also an ultra-bright operating status indicator which shows the operating status and any alarm conditions by means of a traffic light code.

Four simple buttons situated near the display allow the user to:

- display the operating data;
- enter the operating parameters;
- select the language in which the messages are given.
- set running parameters

5.1 Controls

The UPS has the following controls:

- UPS secure powering (protection against accidental powering);
- UPS stopping (to prevent accidental power-offs while allowing the UPS to be quickly shutdown in an emergency. The button must remain depressed for at least 3 seconds);
- buzzer silencer;
- keyboard to browse the menus on the display, set parameters, confirming the selected functions and quitting.

5.2 Measurements

The UPS can manage the following measurements and show the relevant values on the display:

INPUT	OUTPUT	BATTERIES	MISCELLANEOUS	HISTORIC DATA
Current: ▪ Root-mean-square value ▪ Peak value ▪ Peak factor Voltage: ▪ Root-mean-square value Power: ▪ Apparent ▪ Active Power factor Frequency	Current: ▪ Root-mean-square value ▪ Peak value ▪ Peak factor Voltage: ▪ Root-mean-square value Power: ▪ Apparent ▪ Active Power factor Frequency	▪ Charging current ▪ Discharging current ▪ Battery operation time ▪ Residue capacity ▪ Battery voltage ▪ Date/time of last battery calibration	▪ Internal temperature of individual power modules ▪ Ambient temperature	▪ N° of bypass interventions ▪ N° thermal protection interventions with date and time ▪ Number of battery commutations ▪ Number of total discharges Overall time of: ▪ Battery operation ▪ Mains operation

5.3 Adjustments

The will UPS allow the following adjustments to be made and shown on the display:

OUTPUT	INPUT	BYPASS	BATTERIES
▪ Voltage ▪ Frequency ▪ Redundancy N+X	▪ Enable synchronizing ▪ Extended synchronizing interval	▪ Enabling ▪ Forced ▪ Actuation sensitivity ▪ Off line mode ▪ Load waiting mode	▪ Limits ▪ Max. runtime with battery ▪ Max. runtime with battery after reserve limit ▪ Battery test enabling ▪ Auto-restart enabling

5.4 Signals and alarms

The UPS must be equipped with a lighted operating status indicator with traffic light coding not smaller that 600x300 mm as well as a buzzer able to immediately indicate the following operating conditions:

- normal operation (on line)
- output frequency not synchronized with the input
- battery operation
- bypass mode
- faulty power module
- overload
- generic fault
- unit beyond redundancy
- programmed power-off warning
- programmed re-powering warning
- runtime reserve
- end of runtime

5.5 Miscellaneous equipment

5.5.1 Interfaces

The UPS is also equipped with:

- terminals for connecting the EPO (Emergency Power Off) button;
- two DB9 female connectors for the RS232 serial interface;
- one DB15 male connector for the logic signal interface;
- one interface with 5 relay outputs contacts to be set NC or NO by operator panel;
- slot for an SNMP interface that allows the UPS diagnostics, remote control via the network and computer remote shutdown within the battery runtime.

5.5.2 E.P.O.(Emergency Power Off)

The UPS is equipped with an input for a normally closed button (NC). Use of this button immediately stops the whole UPS functions and immediately shuts off the output energy.

5.5.3 RS232 Serial port

The UPS must have two RS232 serial port:

- User Serial Port, placed at the rear of the cabinet
- Service Serial Port, on the front side of the cabinet

The User Serial Port allows to connect the UPS to a Computer and remotely manage the UPS operating functions by a dedicated software.
The service Serial Port also allows to connect the UPS to a Computer in order to execute service and maintenance operations as data reading, diagnostic checks, event memory download, firmware update.

6 Technical specifications

item	***data***
6.1 General Specifications	
UPS Topology	On line double conversion VFI SS 111
Architectiure of the UPS	Modular,scalable, redundant based on 6.7kVA Power Modules
In/Out phase Configuration	Three phase
Neutral	Neutral Passing through
Output wave form on mains run	Sinusoidal
Output wave form on battery run	Sinusoidal
Bypass type	Static and elettromechanic
Transfer time	Zero
6.2 Input	
Nominal Voltage	400 V three phase / 230V single phase
Voltage range	-20% +15%
Frequency	50 Hz o 60Hz (autosensing)
$THDI_{in}$	< 3% al 100% of nominal load
Power Factor	> 0.99 from 50% to 100% of nominal load

6.3 Output with mains (AC-AC)	
Nominal voltage	400 V three phase
Nominal power	80.000 VA
Active power	72.000 W
Voltage variation (static)	± 1%
Voltage variation (dynamic 0-100%; 100-0%)	± 1%
THDv on nominal power (linear load)	< 0,5 %
THDv on nominal power (not linear load P.F.=0,7)	< 1 %
Frequency	50 Hz o 60 Hz (autosensing or selectable)
Frequency tolerance	Synchronized with input frequency or ± 1% free run
Current Crest Factor	3:1 accordingly with IEC EN62040-3
Overload capability: 5 min 30 sec	 125% load rate with no bypass intervention 150% load rate with no bypass intervention
6.4 Output in battery Run (DC-AC)	
Nominal voltage	400 V three phase
Nominal power	80.000 VA
Active power	72.000 W
Voltage variation (static)	± 1%
Voltage variation (dynamic 0-100%; 100-0%)	± 1%
THDv on nominal power (linear load)	< 0,5 %
THDv on nominal power (not linear load P.F.=0,7)	< 1 %
Frequency	50 Hz o 60 Hz (autosensing or selectable)
Frequency tolerance	± 1% free run
Current Crest Factor	3:1 accordingly with IEC EN62 040-3
Overload capability: 5 min 30 sec	 125% load rate with no bypass intervention 125% load rate with no bypass intervention

6.5 Battery	
Type	Lead Acid, sealed, free maintenance VRLA
Unit Capacity	9 Ah (12V)
Nominal UPS Battery Voltage	252 Volt DC
Battery charger type	PWM hi efficiency, one in each power module
Charging Cycle	Intelligent with boost charge and advanced management
Max Charging Current	2,5 A each power module
6.6 Environmental specs	
Noise level @ 1m	50 ÷ 65 dBA
Working temperature range	from 0°C to +40°C
Stock temperature range	from -20°C to +50°C (excluded batteries)
Humidity range	20-80% not condensing
Protection degree	IP21
6.7 Mechanical an Michellaneous	
Net Weight with out batteries[3]	272 kg
Dimensions (W×H×D)[4]	1 x (570 x 2080 x 912) (mm)

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[3] The weigh depends by the number of the installed batteries accordingly with the required autonomy.
[4] The battery cabient dimension can change depending battery set accordingly with the required autonomy.

Colour	RAL 7016
Technology rectifier/booster/inverter	MOSFET/IGBT
Communication Interface	2 serial port RS232, 1 logicic level port, 5 Dry contacts port
Input/Output connections	3P + N + PE Connectors on omega bar
Number of Installed Power Modules	12 of 6.7000 VA
Standards	EN 62040-1, EN 62040-2, EN 62040-3

The UPS Manifacturer Company must have ISO9001 certification for development, production, and services.

1 REFERENCE STANDARDS

The static uninterruptible power system must be designed and produced in compliance with the following international standards:

- EN 62040-1 "General and safety requirements for UPS used in operator access areas"
- EN 62040-2 "Electromagnetic compatibility requirements (EMC)"
- EN 62040-3 "Performance requirements and test methods"

The UPS must have CE marking in accordance with European Directives 73/23, 93/68, 89/336, 92/31, 93/68.