



सत्यमेव जयते

भारत सरकार –रेल मंत्रालय

अनुसंधान अभिकल्प एवं मानक संगठन

GOVERNMENT OF INDIA - MINISTRY OF RAILWAYS

विशिष्ट सं० आरडीएसओ/पीई/स्पेक/पीएस/0023-2001 (रिवी. 0), एमेन्ड.4

SPECIFICATION No. RDSO/PE/SPEC/PS/0023- 2001 (Rev-0) Amdt No. 4

पीआरएस, ईडीपी सेंटर और अन्य समान आवश्यकताओं के लिए ऑन लाईन यूपीएस पद्धति के फाल्ट टोलरेंट निर्बाद्धित विद्युत आपूर्ति (यूपीएस) सिस्टम हेतु तकनीकी विशिष्टि

**TECHNICAL SPECIFICATION FOR FAULT TOLERANT
UNINTERRUPTED POWER SUPPLY (UPS) SYSTEM FOR PRS, EDP CENTERS
AND OTHER SIMILAR REQUIREMENTS OF ONLINE UPS SYSTEM**

Sl.No.	Date of amendment	Revision / Amendment	Page no.	Remarks
1	08.07.09	1	-	Added Clause 5.2.32 for SNMP communication port
2	16.09.2010	2	12 &13	Clauses 8.0, 12.0, 15.0, and 17.0 deleted, and clause 7.0 modified as per Railway Board letter No.2006/Elect (G)/150/9/Pt dated 10.09.2010.
3	16.09.2011	3	-	Heading and Clauses 1.0, 2.1, 4.1, 4.2, 4.6, 4.9, 5.1.1, 5.2.5, 5.2.8, 5.2.9, 5.2.24, 5.2.28, 5.2.31, 5.2.32, 5.2.33, 5.3.1, 5.3.3, 5.3.6, 5.4.2, 5.4.3 (a), (g), (j), (h), 5.4.4 (B), 6.0, 6.2, 6.6, 7.0-(i) modified Clauses 5.2.34, 5.2.35, 10.3, Annexure-A & B added Clause 5.4.5, 6.1 deleted
4				Final Draft

जारीकर्ता

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SPECIFICATION FOR FAULT TOLERANT UNINTERRUPTED POWER SUPPLY (UPS) SYSTEM FOR PRS, EDP CENTERS AND OTHER SIMILAR REQUIREMENTS OF ONLINE UPS SYSTEM

1.0 SCOPE

The specification lays down the requirement of design, manufacturing, service, packing and forwarding of fault tolerant static Uninterrupted Power Supply (UPS) system (1+1 configuration) for PRS, EDP centers and other similar requirements of online UPS system. Basically, the spec. addresses the requirement of applications requiring UPS of high fault tolerance/reliability.

2.0 CODES AND STANDARDS

- 2.1 The UPS shall comply with the requirements of latest issue of relevant Indian Standard/ IEC. Some of the applicable IS/IEC standards are listed below:

IEC:62040-1 Ed. 1.0 b	Specification for UPS- General and Safety requirements
IEC:62040-2	Specification for UPS-EMC requirement
IEC:62040-3	Method of specifying the performance and test requirements of UPS
IS : 9000	Environmental test
IEC : 61643	Surge Protection Devices

- 2.2 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force.
- 2.3 In case of any contradiction between the standards listed in Cl. 2.1 and this specification, the requirements laid down in this specification shall prevail.

3.0 SITE CONDITIONS

The UPS shall perform satisfactorily in a room at: ambient temperature in the range 0°C to 40°C, altitude not exceeding 1,000M above MSL and Relative Humidity 95% RH non-condensing.

4.0 GENERAL REQUIREMENTS

- 4.1 The UPS system shall be an integrated system comprising of input rectifier, charger, inverter, static bypass switch and manual bypass switch. The charger shall be designed such that it shall be able to charge the battery in constant voltage, constant current mode. Charging capacity shall be at the rate of 0.1C ('C' is the AH capacity of the Battery).
- 4.2 The UPS system shall be of 1+1 configuration and shall be able to configure in hot standby with bypass. The configuration of the UPS shall be such that the bypass line of the primary UPS shall be connected to the inverter of the secondary UPS. The bypass line of secondary UPS shall be connected to the bypass main source. Unless otherwise specified by the purchaser in the

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tender (see Annex-A item 2 (ii)), both the UPS shall use a common battery bank. At any given point of time, only one UPS shall carry the load. In the event of failure of working UPS, the load shall be automatically transferred to the standby UPS (through static switch) without causing a spurious load trip. In case of category 'C', if both the UPS fail, the supply shall be transferred automatically to the (stabilized) mains source through the static bypass switch. In category 'A' and 'B', if both the UPS fail, the supply shall not be automatically transferred to the main source and the load will face power outage; however, in such case, the railway staff can (in exceptional cases) make use of manual bypass switch to feed the load through the mains power (if the power quality of mains source on the site is acceptable).

- 4.3 Current sharing parallel redundant system is not desired.
- 4.4 **Deleted.**
- 4.5 The UPS system shall be suitable to feed all loads connected to output which are primarily computers, printers, servers, scanners, modems, etc.
- 4.6 The UPS system shall be of true double conversion with an in-built isolation transformer (copper wound) and shall be based on latest generation technology having proven performance of satisfactory operation for similar applications. UPS of upto 5 kVA capacity shall be provided with inverter of type PWM MOSFET or PWM IGBT. In UPS of capacity higher than 5 kVA, inverter of type PWM IGBT (IGBT modules only) shall be provided. All components shall be of quality and reliability that satisfies the requirements of a secure AC power to vital equipment. Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and circuit switching operations, etc.
- 4.7 The design of UPS shall be such as to withstand short circuit at load without causing an adverse effect on the UPS.
- 4.8 The manufacturer shall be responsible for design, engineering and manufacturing of the complete system to fully meet the intent and requirements of this specification.
- 4.9 The UPS can be single phase or three-phase system as indicated below for different ratings.
- | | |
|------------|---|
| Category A | 1 kVA to 7.5 kVA with single-phase input and single phase output. |
| Category B | 7.5 kVA to 30 kVA with three phase input and single phase output. |
| Category C | 10 kVA and above with three phase input and three phase output. |

The purchaser while tendering shall indicate the type of UPS required (see item 1 (i) & (ii) of Annex-A).

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5.0 TECHNICAL REQUIREMENTS

5.1 Input power supply

5.1.1 The UPS shall be suitable for the following input power supply:

i)	For category B&C	
	Voltage	350V - 475V for 3 phase
	Frequency	50 Hz \pm 8%
ii)	For category A	
	Voltage	160V -280V for single 1 phase*
	Frequency	50 Hz \pm 8%

* Standard voltage range is 160V – 280V. Optionally, the purchaser can ask for voltage range of 140V – 280V for Category A (see item 1(iii) of Annex-A)

5.2 UPS design & performance requirements

5.2.1 Incoming AC supplies shall be converted to DC through input rectifier. The rectifier/charger shall operate according to the constant voltage current limiting principle and shall incorporate a “Soft Start” feature to gradually accept load on initial energizing.

5.2.2 The rectifier section/battery charger of the UPS system shall be capable of precise regulation to prevent damage to the battery. The output voltage of rectifier’s DC bus without the battery shall be stabilized to within 2% of set value during load variation between 0 to 100% of the rectifiers and specified mains input supply voltage variation. Current ripple shall be less than 3%.

5.2.3 Deleted.

5.2.4 Appropriate provision of R.F. filters shall be made to suppress the radio frequency interference.

5.2.5 Transient/surge protection shall be provided in the input circuit to rectifiers to protect the UPS from surges & voltage spikes. Class C type SPD of appropriate rating with indication should be used where chances of lightning strikes are more or at those places where the chances of indirect surges in power supply are high. Otherwise, conventional surge protection with MOVs is to be done. Provision of Class C type SPD will be an optional feature and is not to be provided, unless specifically called for in the indent / tender (see Annex-A item 1 (vii)).

5.2.6 UPS shall be designed to operate satisfactorily while deriving power from an emergency diesel generating set. Suitable protection shall be provided in the control circuits to guard against electrical oscillations which may be present in the input supply as caused by emergency DG sets.

5.2.7 The UPS shall be provided with automatic sequence and power walk/ soft start in circuit(s) with appropriate time delay such that the rectifiers and

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inverters can start operating automatically when incoming AC power is restored allowing the UPS to be loaded automatically.

5.2.8 **Sealed Maintenance Free** (SMF) lead acid Batteries, having testing reports of NABL approved laboratory of one of the following make --- Amara Raja/ Exide/ CSB/ Panasonic/ Hitachi/ Yuasa shall be provided (2 Volt single cells or in the form of crate of 6V/12V preferable). Battery of other make can also be provided **if the same is found to be acceptable at design scrutiny stage.**

5.2.9 For prescribing the battery **VAH (see item 2(i) of Annex-A)**, the purchaser will consider the following :

- a. Load Power Factor of 0.65 to unity
- b. Minimum ambient temperature shall be taken as 27°C.
- c. Battery Current = Inverter rated VA X Power factor/ (Inverter efficiency X End cell voltage X No. of cells).
- d. Ageing factor of 0.8.
- e. Back up time of half an hour in case of mains power failure for category B & C and two hours **backup** for category A **or as desired by the purchaser.**
- f. Minimum end cell voltage for lead acid battery 1.75V per cell. Battery low pre-alarm to be set at 1.8 volts per cell.

5.2.10 The rectifiers/ chargers shall be designed to completely re-charge the battery in a maximum time of 10 hours after complete discharge. The rectifier/charger shall be sized based on the maximum inverter input load when inverter is delivering its rated output at 0.8 pf lagging and recharge the battery to nominal rated capacity of the battery.

5.2.11 The rectifiers/charger shall sense the battery charging current and adjust the DC bus voltage to maintain the charging current to pre-set level. A separate current limit circuit shall also be provided for adjustment of battery current. Subsequent to a discharge cycle when battery is connected to rectifier/charger, the battery current shall be monitored, controlled and limited to set value automatically, irrespective of the inverter input current. The rectifier shall be protected against reverse battery connection at dc link voltage.

5.2.12 **Deleted.**

5.2.13 **Deleted.**

5.2.14 **Deleted.**

5.2.15 The UPS output voltage waveform shall be sinusoidal. The **Total Harmonic Distortion (THD)** of voltage waveform at inverter output (at full load and rated p.f.) shall not exceed 3% for linear load and 15% under non-linear load.

5.2.16 The UPS system shall be able to operate satisfactorily on rated loads (in kVA) with power factors in the range of 0.65 lag to 1.0. The overall efficiency of 'B' and 'C' category UPS at rated load at 0.8 pf and at nominal input voltage shall be minimum 85%. In respect of 'A' category UPS, under the aforesaid load, load pf and input voltage, the minimum efficiency requirement shall be as follows: 75% for ≤ 3 kVA and 80% for > 3 kVA.

5.2.17 The UPS shall have capacity to deliver a minimum overload of 125% for 10 minutes and 150% for 60 sec. UPS shall be provided with current limit circuit to avoid excessive loading beyond its permissible overload withstand capability.

5.2.18 Deleted.

5.2.19 Unless otherwise specified, the voltage variation shall not exceed $\pm 5\%$ and complete recovery to normal steady state shall be within 40 ms for the following transient disturbances:

- a) 100% step load and unload
- b) 50% step load.
- c) Momentary interruption in power supply.
- d) Deleted.
- e) Deleted.

5.2.20 The battery may be taken out of service for maintenance during which period it shall be possible for the UPS to continue operation by drawing power from the rectifier.

5.2.21 In case of 100% balanced 3-phase load, the angle variation between the phases shall not exceed 1 degree. Under the condition of 100% unbalanced 3-phase load, the maximum output voltage and angle variation between the phases shall not exceed 4% and 3 degrees respectively.

5.2.22 Deleted.

5.2.23 All Isolator/breakers shall be adequately rated for continuous rating as well as breaking capacity as applicable. Paralleling of breaker/switch/contactors poles to achieve the required current is not acceptable. Output isolating devices shall be double pole type for 1-phase and four pole type for 3-phase.

5.2.24 All the thyristors, diodes, IGBTs and other electronic devices of UPS shall be given adequate protection from short circuits.

5.2.25 All PCBs shall be provided with a transparent epoxy coating for environmental protection and tropicalisation. They shall be suitably located away from heat sources.

5.2.26 All electronic control and monitoring printed circuit cards shall be suitable for easy replacement. Monitoring points shall be provided with identification on each of the PCBs and the PCB shall be firmly clamped in position so that vibration or long usage does not result in loose contacts.

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5.2.27 Fans, **if any**, shall be of good quality and high reliability. The failure of fan shall only cause thermal tripping at pre-set temperature, without causing any damage.

5.2.28 Maximum noise level from UPS system measured from a distance of 1 meter from UPS in all directions under rated load shall not exceed:

- a) 55 dB for Category A
- b) 65 dB for Category B
- c) 75 dB for Category C

5.2.29 Remote Emergency Power off (REPO) – Provision shall be available in category B & C for a wired REPO switch which shall electronically shut down the UPS by turning off the rectifier, inverter switch and battery circuit breaker.

5.2.30 Maintenance bypass isolator – Provision shall be available for manually operated maintenance bypass isolator which shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power source bypassing the rectifier, inverter and static transfer switch.

5.2.31 **Deleted.**

5.2.32 UPS shall be provided with capability to support SNMP (Smart Network Management Protocol) communication port with hardware and software for remote monitoring. This will be an optional feature and is not to be provided, unless specifically called for in the indent/ tender **(see item 1(v) of Annex-A)**.

5.2.33 The UPS shall have a data logging facility, with USB download capability. This will be an optional feature and is not to be provided, unless specifically called for in the indent / tender **(see item 1(iv) of Annex-A)**. The data logged shall be:

- a) 80 faults in a FIFO with date and time stamp (faults to be recorded include, but are not limited to those listed in section 5.4.4 (B))
- b) The LCD display shall enable interrogation of the fault data log by the operator

5.2.34 **Periodic changeover of UPS**

- a) Load shall be transferred between UPS 1 and UPS 2 at appropriate pre-set time intervals **(the interval is to be decided by railway's site engineer)**. In UPS of Category 'A', the changeover shall be carried out manually by railway staff. However, in UPS of Category 'B' and 'C', the manufacturer will supply the necessary electronics and render the changeover an automatic process **(the railway must convey its desired changeover interval to the firm at design stage)**.
- b) Load shall be transferred to the other UPS after **the time interval as aforementioned**, even if the UPS supplying the load is healthy.
- c) Deleted
- d) Deleted

5.2.35A visual indication and audio alarm shall be provided for load on bypass mode or if any one of the UPS is defective. Such visual indication and audio alarm are to be provided at the place where the operators of the system are available so as to alert them about the abnormality in the system. This will be an optional feature and is not to be provided, unless specifically called for in the indent/ tender (see item 1(vi) of Annex-A).

5.3 Construction

5.3.1 Rectifier/charger, inverter and static switch sections shall be suitably housed in sheet steel panels complete with all interconnections. The panels shall be fabricated with cold rolled sheet steel/ structural steel min. 1.2 mm thick for Cat A and 1.6 mm thick for Cat B & C. The panels shall be free standing, fitted with suitable louvers for ventilation and cooling fans as required. Hinged doors shall be provided at the front. The enclosure shall provide minimum IP-20 degree of protection.

5.3.2 UPS system shall be suitable for either floating output or earthed neutral, or earthing of star point, in case of single phase/three phase system respectively.

5.3.3 In Category 'C' UPS, bypass supply shall be stabilized (through servo controlled voltage stabilizer) so as to regulate the output voltage within $\pm 2\%$ of the rated voltage over complete range of load from no load to full load and for specified input supply voltage variation. The said servo controlled voltage stabiliser can be of the UPS manufacturer's own make or an alternate make, if the latter is found to be acceptable at design scrutiny stage. In UPS category 'A' and 'B', no voltage stabilizer shall be provided for the bypass mains supply.

5.3.4 The rating of UPS as specified in the data sheet shall be the net output of UPS after deducting power consumption for fans, etc.

5.3.5 A suitable sized earthing point shall be provided either at the bottom of the panels or at the back side of the panels.

5.3.6 Cables and terminal blocks (if any) for power or control cable connections should be of appropriate voltage, current and temperature rating.

5.3.7 All control wiring shall preferably be enclosed in plastic channel or otherwise neatly bunched together.

5.3.8 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The exterior of the panel shall be spray painted with two coats of epoxy based panel paint or powder coated.

5.3.9 **Battery Accessories:** Batteries if provided outside the UPS system, shall be in a formation which is commensurate with the available space. The stand shall be made of standard L angle channel and duly spray painted with two coats of epoxy based panel paint or powder coated.

5.4 Summary list of key technical requirements and the related spec. clauses

5.4.1 Technology - True Online Double Conversion.

5.4.2 Input -

a)	Voltage	As per Cl. 5.1.1
b)	Frequency range	As per Cl. 5.1.1
c)	Power factor measured at input terminal shall be more than 0.8 at full load (rectifier/ charger is to be designed accordingly)	

5.4.3 Output -

a)	Voltage	230V \pm 1% for single phase 400V \pm 1% for three phase
b)	Output frequency	50 \pm 0.5 Hz (free running)
c)	Output Waveform	As per Cl. 5.2.15
d)	Load Power Factor	As per Cl. 5.2.16
e)	Transient response	As per Cl. 5.2.19
f)	Transient recovery time.	As per Cl. 5.2.19
g)	Phase displacement (for 3 phase output only)	As per Cl. 5.2.21
h)	Total Harmonic Distortion	As per Cl. 5.2.15
i)	Overall efficiency	As per Cl. 5.2.16
j)	Overload Capacity	As per Cl. 5.2.17
k)	Crest Factor	3:1
l)	Type of battery	As per Cl. 5.2.8
m)	Battery VAH	The Purchase Order (P.O.) shall only specify the Battery VAH requirement (the P.O. shall not specify the battery Voltage and AH) and the firm will need to comply the VAH.
n)	Environment Conditions	As per Cl. 3.0

5.4.4 PROTECTION/INDICATION/METERING ETC.

(A) Following protections shall be available :

- i) Overload.
- ii) Short circuit at output of UPS.
- iii) Over and under voltage at battery terminals.
- iv) Over temperature
- v) Input surge protection.

(B) Following indications shall be available :

1. Charger On/Mains presence.
2. Mains Normal / Abnormal.
3. Low Battery.
4. Load on bypass.
5. UPS On.
6. UPS Trip.

7. Audible alarm for mains failure, battery low pre-alarm, battery low trip and inverter trip.
8. Visual indication and audio alarm near working place of operators (on **specific mention** by the purchaser in indent/tender – see Cl. 5.2.35 of the spec. and item 1(vi) of Annex-A)
9. Indication for SPD failure (wherever **requirement** of SPDs **has** been **specifically mentioned** by the purchaser in indent/ tender – see Cl. 5.2.5 of the spec. and item 1(vii) of Annex-A)

(C) Monitoring by analogue Meter/LCD Display for the following :

- (i) AC Input voltage
- (ii) AC Output voltage
- (iii) AC Output current
- (iv) Battery voltage
- (v) Battery charging & discharging current
- (vi) Output frequency
- (vii) Deleted

5.4.5 Deleted

5.4.6 Controls

- (a) All the switch for starting, shut down and testing sequence.
- (b) Primary input circuit breakers for feeding chargers, bypass line and DC bus from battery including backup protection.
- (c) Inverter ON/OFF switch (to initiate inverter operation).
- (d) **Deleted.**
- (e) Emergency shut down switches on the panel.

5.4.7 Reliability

All necessary care shall be taken in selection, design and manufacture, testing and commissioning of the equipment for ensuring high system reliability.

5.4.7.1 Deleted

6.0 TESTS

Separate type, acceptance, routine and investigation tests for UPS shall be conducted.

R-L load equivalent to the rated capacity of the UPS in kVA with 0.8 pf shall be arranged at the manufacturers' premises by the manufacturer for the purpose of testing. Various tests shall be performed by simulating the combination of inductive and resistive load of adequate capacity matching the rating of the UPS.

RDSO may conduct surprise check on manufacturing process and quality control along with any of the test to ensure quality of product and its conformance to RDSO's specification.

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6.1 Deleted**6.2 TYPE TESTS**

Type test units shall be inspected/ tested by RDSO at manufacturer's premises or where the type tests are arranged. Type tests shall be carried out on one UPS unit of given design to verify if the product meets the requirements specified and agreed upon between user and manufacturer. Subject to agreement between user and manufacturer, some or all the type tests shall be repeated whenever required by RDSO or purchaser on sample basis, so as to confirm the quality of the product to meet the specified requirements. In addition, the manufacturer shall repeat the type test to be witnessed by representative of RDSO or purchaser either totally or in part in following cases without any additional cost:

- Modification of equipment likely to affect its function.
- Failure or variations established during type or routine tests
- In any other condition where RDSO/Purchaser felt necessity of the type test.

6.3 ACCEPTANCE TESTS

The acceptance tests are to be conducted in the presence of railways' nominated representative on the samples selected at random or on all as agreed between purchaser and manufacturer, to establish conformity of the lot to be supplied with the requirements of the specification. Purchaser has the right to insist for acceptance tests on each unit in the presence of his nominated representative.

6.4 ROUTINE TESTS

These tests are to be carried out to verify the properties of the product corresponding to those measured during type tests. Routine tests are to be performed by the manufacturer on each equipment and all the records of test results shall be maintained with traceability. The same shall be produced before the railway inspecting officer/ representative to verify the routine test results.

6.5 INVESTIGATION TESTS

Based on the performance, field experience, in case of critical failures in the system or in view of the improvement measures, investigation tests shall be carried out. These tests shall be especially requested either by RDSO or user or by the manufacturer.

6.6 TESTING SCHEDULE

S.No	Test	Type#	Routine	Acceptance test	Sub Clause no. of IEC 62040-3.
1.	Interconnection Cable Check	X	X		6.6.1
2.	Light Load Test	X	X	X	6.6.3
3.	Synchronisation Test	X			6.6.5

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4.	AC Input failure test	X	X	X	6.6.6
5.	AC Input return test	X	X	X	6.6.7
6.	Transfer Test	X	X	X	6.6.9
7.	Full Load Test	X	X	X	6.6.10*
8.	UPS Efficiency	X	X	X	6.6.11
9.	Unbalance Load Test	X			6.6.12
10.	Output voltage unbalance	X			6.3.4.5
11.	Rated stored energy time/Battery backup test.	X		X	6.6.15
12.	Rated restored energy time	X		X	6.6.16
13.	Battery Ripple current	X			6.6.17
14.	Overload capability test	X			6.6.18
15.	Short circuit current capability	X	X	X	6.6.19
16.	Restart	X	X	X	6.6.21
17.	Output over voltage test	X			6.6.22
18.	Harmonic component test	X			6.6.26
19.	Audible Noise test				7.3
20.	Simulation of hot standby redundant test.	X	X	X	As per RDSO clause 4.2
21.	Dry heat test	X			As per IS 9000 and 60068-2-2

Note-1 - A certificate from NABL approved test laboratory shall be provided for compliance to EMI/EMC requirements for UPS.

Note-2 - For certain tests, the type testing authority i.e. RDSO may choose to rely upon previous type test reports/conformance certificates, as long as they pertain to similar design and comparable rating. However, the manufacturer cannot demand this as a matter of right.

* In addition to the setup specified in Clause 6.6.10 of IEC 62040-3, the UPS is to be tested at rated full load unity power factor and battery connected in fully discharged condition. The temperature rise should be within 70% of the rated temperature of the device.

Until the railways are able to issue their vendor list, they may in the interim period invite tender/ place order with the provision of accepting the material on the basis of firm's written clause-by-clause confirmation of the spec. and acceptance test alone, **wherever this is considered necessary by CEE.**

7.0 OTHER CONDITIONS :

- (i) The manufacturer(s) shall possess ISO 9001 certification.
- (ii) Deleted.
- (iii) Deleted.
- (iv) Manufacturer must submit the details of approval certificates of ISO, Railways, DGS&D, etc.
- (v) Clause-by clause statement of compliance with the specification
- (vi) Deleted.
- (vii) Deleted.
- (viii) Deleted.

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8.0 INFRASTRUCTURE FOR QUALITY ASSURANCE

Deleted.

9.0 TECHNICAL PARTICULARS ALONG WITH THE OFFER

The manufacturer shall furnish/submit full technical details of offer together with full descriptive literature and technical particulars of the equipments offered. Clause by clause compliance along with other details, as called for in this specification, has to be furnished along with the offer. Incomplete details shall render the offer liable for rejection.

10. INFORMATION TO BE SUPPLIED BY THE MANUFACTURER AND PURCHASER

10.1 The manufacturer shall submit all relevant information to the purchaser, while offering for type testing.

10.2 **Manuals, Data and Technical Information** – The following detailed data and information shall be supplied to railway in triplicate by the manufacturer:

- i. Installation procedure.
- ii. Operation and maintenance manuals and maintenance schedule – 3 sets.
- iii. Test certificates of the major components.

10.3 Technical details to be furnished by the purchaser in his requisition are given in Annexure A and technical data to be furnished by the tenderer in his offer are given in Annexure B.

11.0 CARE OF BUILDING

Care shall be taken in handling / stacking of material to avoid damage to the building. On completion of the UPS installation, manufacturer shall remove all debris caused by him and leave the area in a neat and clean state.

12.0 GUARANTEE

- i. Deleted.
- ii. Deleted.
- iii. Deleted.
- iv. Deleted.

13.0 COMPLETION DRAWING

13.1 3 sets of complete drawings shall be handed over to the Railways while handing over the installation.

14. TRAINING OF DEPARTMENTAL PERSONNEL

14.1 Adequate railway personnel as mutually agreed upon shall be required to be trained free of cost. The manufacturer shall undertake to train them within a reasonable period at manufacturer's works for operation and maintenance.

15. AFTER-SALE-SERVICE

15.1 Deleted.

16.0 PAINTING AND PROTECTION

16.1 The entire equipment shall be tropically finished and constructed in the best workmanship. All damages in transit and installation shall be set right/repaired to the satisfaction of the Railways.

17.0 SERVICE CAPABILITY

17.1 Deleted.

FINAL DRAFT

Prepared by:

JE/EM

Checked by:

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Annexure - A

Technical details to be furnished by the purchaser in his requisition

1. UPS (1+1 configuration)

i)	Type of UPS i.e. A, B, or C (see Cl. 4.9)	
ii)	Rating of UPS (see Cl. 4.9)	
iii)	Input voltage range (see Cl. 5.1.1).	
iv)	Data logging facility (see Cl. 5.2.33)	Yes/No
v)	SNMP (Smart Network Management Protocol) (see Cl. 5.2.32)	Yes/No
vi)	Visual indication and audio alarm near working place of operators (see Cl. 5.2.35)	Yes/No
vii)	Provision of SPD (see Cl. 5.2.5)	Yes/No

2. Battery

(i) \$	Capacity of battery in VAH (see Cl. 5.2.9)	
(ii) \$\$	If the site requires a redundant battery bank, then please mention 'Yes' (see Cl. 4.2). Even if the purchaser asks for redundant battery bank, at any given point of time, only one battery bank will supply the load i.e. two parallelly connected load sharing battery banks are not intended. The option 'No' shall imply common battery bank [see Cl. 4.2].	Yes/ No

\$ Purchaser must take care not to specify Battery Voltage and A.Hr. Only the VAH should be specified by the purchaser. In similar vein, the Purchase Order must take care not to specify Battery Voltage and A.Hr and only the VAH should be specified in the P.O. After placement of P.O., if the firm has supplied the VAH \geq that specified in the P.O., then the same will be adequate.

\$\$ If the purchaser requires a redundant battery bank, then while stating the VAH under 2 (i), he must take care to state the VAH in the following manner: '2 x ____ VAH'. For instance, if in an application a common battery bank of say 4,000 VAH can take care of the backup requirement, then if the purchaser chooses to opt for redundant battery bank, then he must state the VAH requirement as 2 x 4,000 VAH. In such case, the P.O. must also mention the VAH in the same manner.

Prepared by: JE/EM	Checked by: JD/EM
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Annexure - B

Technical data to be furnished by the tenderer in his offer

1. UPS (1+1 configuration)

i)	Make and model no.?	
ii)	Type of UPS i.e. A, B, or C ? (see Cl. 4.9)	
iii)	Rating of UPS?	
iv)	Single Phase/ Three Phase?	
v)	Input voltage range? (see Cl. 5.1.1)	
vi)	Input frequency range?	
vii)	Output voltage range?	
viii)	Output frequency range?	
ix)	Output voltage waveform?	
x)	Overall efficiency at 0.8 PF?	
xi)	Overload capacity?	
xii)	Power factor at input terminals on full load?	
xiii)	Transient recovery time?	
xiv)	Total Harmonic Distortion of output voltage for linear and nonlinear loads?	
xv)	Max. time for charging the battery from fully discharged state	
xvi)	Noise level from UPS system?	
xvii)	Confirmation that copper wound isolation transformer is provided [see Cl. 4.6]	
xviii)	Inverter type? (PWM MOSFET/ PWM IGBT) [see Cl. 4.6]	
xix)	Deleted	
xx)	Transient/ surge protection at input? (see Cl. 5.2.5) (Yes/No)	
xxi)	Deleted	
xxii)	Data logging facility? (see Cl. 5.2.33) (Yes/No)	
xxiii)	SNMP (Smart Network Management Protocol)? (see Cl. 5.2.32) (Yes/No)	
xxiv)	Visual indication and audio alarm near working place of operators? (see Cl. 5.2.35) (Yes/No)	
xxv)	Provision of SPD? (see Cl. 5.2.5) (Yes/No)	

2. Battery

i)	Make and model no.?	
ii)	Battery type?	
iii)	VAH rating of battery?	
iv)	Is redundant battery bank provided (see Cl. 4.2) [Yes/ No]	

Prepared by:	Checked by:
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