PROJECTS: THDC VISHNUGARH-PIPALKOTI HEP (4x111 MW)

Corrigendum:

Revised (R-1) Specification changes are highlighted in GREEN colour.

SPECIFICATION

FOR

UPS & BATTERY

PRE QUALIFICATION REQUIREMENT (PQR)

The UPS system offered for this tender shall have at least one (1) year satisfactory operation prior to the 01-08-2025 in **Two(2) power plant (Hydro/Thermal) or process industries like oil refineries, steel plant, cement plant etc out of that one (1) performance certificate should be in power plant (Hydro/Thermal) . The rating of such UPS shall be 45 kVA with 3-Phase /1-Phase configuration or above.**

Satisfactory Performance Certificate from End User shall be submitted for verification. In absence of this Satisfactory Performance Certificate from End-User, technical offers is liable to be rejected.

Bidder meeting PQR but not an approved Bidder of M/s THDC credentials of such Bidder will be sent to customer for approval. Technical offer of only bidders approved by M/s THDC shall be considered.

REVISION:1

APPROVED

(Amit Kr Sharma)
DGM(CE-Engg-BPE)

PREPARED	ISSUED	DATE
(Albert Banerjee) Sr. Manager, CE-Engg-BPE	416	23/08/2025

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PROJECTS: THDC VISHNUGARH-PIPALKOTI HEP (4x111 MW)

SCOPE OF SUPPLY

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SCOPE OF SUPPLY

Following UPS systems shall be as per Technical Requirement and detailed Scope of Supply.

A) BILL OF MATERIAL:

UPS Configuration: Each UPS System (45 KVA each) shall consist of 1x100% input isolation transformer, 1x100% charger and inverter, 1x100% battery bank (common) as per SLD, bypass line transformers (common) & voltage stabilizer (common), manual bypass switch, 1x100% ACDB (for each UPS), 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS-common) and other necessary protective devices and accessories.

General :

UPS offered should have IGBT based inverter and SCR based rectifier with fully controlled design.

Accessories: Anti-vibration Pad, Base Frame, interconnecting cables between UPS & SCVS, Cable Glands & Lugs for 415V AC incoming power cables, UPS to Battery, UPS to ACDB, interconnecting cables (50 meters per run) along with lugs at both BHMS and Battery end for BHMS, MODBUS TCP/IP (300 meters), etc.

Wall mounted Battery Isolation Box with MCCB of suitable rating to be provided for isolation of the battery with UPS in battery room.

(*Battery AH rating for sizing Charger & Transformer shall be calculated as per Battery sizing methodology attached*).

Interconnecting cables, glands & Lugs :

Interconnecting cables between UPS to Battery and UPS to ACDB is in Bidder scope.
Cable Glands and Lugs shall be provided by bidder for cables mentioned below for each project:

a) 415V AC MCC to UPS Incomer: 3C x 95 sq.mm Aluminium conductor
b) UPS to Battery: Suitable Uninyvin cable to be provided by bidder (50m Distance)
c) UPS to ACDB-1 & II: Suitable Uninyvin cable to be provided by bidder (50m Distance each)

Glands & Lug requirement will be finalized during detail engineering and same shall be supplied without any cost implication to BHEL after award of the contract.

Uninyvin cables are to be sized based on the voltage drop criteria as below.

1) Max 4V voltage drop between UPS to BATTERY
2) Max 2V voltage drop between UPS to ACDB

Bidders have to submit the voltage drop calculations of each Uninyvin cables selected above.

DETAILED SCOPE OF SUPPLY

1) 2 X 45KVA UPS ALONG WITH (ACDB-I &II)– 1 SET
2) 2V SMF VRLA BATTERY (1 HR BACKUP) – 1SET
3) BHMS WITH INTERCONNECTING CABLES—1SET
4) BATTERY ISOLATION BOX (WITH MCCB) – 1SET
5) GLANDS & LUGS – 1 LOT
6) MANDATORY SPARES (UPS+ACDB) – 1LOT (REFER BELOW BOQ)
7) INTERCONNECTING CABLES UNINYVIN CABLE FOR UPS TO BATTERY & UPS TO ACDB-1LOT
8) DRB -1SET
9) MODBUS CABLES (300 METERS) -1LOT

Note: Bidder to submit Modbus protocol with details of bit assigned for each signals,Battery sizing calculations & uninyvin cable sizing with voltage drop calculations. Offers of the bidders will be rejected if above are not submitted.

MANDATORY SPARES FOR UPS:

The following mandatory spare parts shall be included in the offer:
i) MCCB & MCB of each rating/type minimum of 1 No. each
ii) Printed circuit cards of each type used 2sets
iii) Indicating lamps with lamp covers 10% of total
iv) Terminal blocks 10% of total
v) Selector switches of each type/rating 2 Sets.
vi) Indicating instruments with transducers 2 Sets of each size/type
vii) Relay each type 2 Nos.
viii) HRC fuses of each type / size 3 Sets
ix) Sensors, transducers etc. of each type/size 10% of total with minimum of 2 Nos.
x) Cooling fan 2set

ACDB SPARE REQUIREMENTS

Sr.No	Description	Qty
1	Circuit breaker of each type and size used	5 Nos.
2	Indicating lamps of each type	10 Nos.
3	Fuse of each type and rating	2 Nos.
4	Voltmeter & Ammeter each type	1 Nos.

1.0 GENERAL TECHNICAL REQUIREMENTS

1.1 Only the type tested (in the last 10 years), electronic modules will be acceptable unless otherwise decided by the purchaser in special circumstances.

1.2 For UPS, the type test shall be as per IEC-146, Degree of Protection test as per IS-2147 and the same are not to be specifically conducted for the projects if conducted on similar type/rating or similar type/ higher rating UPS. If type tests are not available with supplier, then type tests has to be conducted and reports has to be submitted without any price implication to BHEL.

1.3 Routine & Acceptance tests shall be done as per relevant standards. Temperature rise test is also to be done 100% for 10-12 hours' duration each time (till temperature stabilizes).

1.4 Erection supervision & commissioning of Battery with overall integration of complete system is responsibility of UPS Bidder.

2.0 DOCUMENTS TO BE FURNISHED

2.1. **Along with the technical bids:** Bidder must submit soft copy of following documents along with the technical bids

A. a) Datasheet/Drawings of UPS System:

a) Scope of Supply
b) Charger & Transformer Sizing Calculation
c) Technical datasheets of UPS, Stabilizer, ACDB, BHMS, PDB, etc.
d) Heat Loss Calculation
e) Bill of Material of UPS, Stabilizer, ACBD, BHMS, Cable Glands & Lugs, PDB, etc.
f) Single Line Diagram
g) Catalog

2.2 **After Placement of Purchase order:** Bidder must submit soft copy of following documents for submission to Customer / Consultant.

B. a) Datasheet/Drawings of UPS System:

h) Covering Sheet
i) Index Sheet
j) Scope of Supply
k) Charger & Transformer Sizing Calculation
l) Technical datasheets of UPS, Stabilizer, ACDB, BHMS, PDB, etc.
m) Heat Loss Calculation
n) Bill of Material of UPS, Stabilizer, ACBD, BHMS, Cable Glands & Lugs, PDB, etc.
o) Panel GA drawings including Internal View of INV/UPS, Stabilizer, ACDB, BHMS, PDB, etc.
p) Single Line Diagram

q) Interconnection Drawing
r) Earthing Drawing
s) Power Circuit Drawing
t) Analog & Binary Signal List (pdf & excel format)
u) ACDB Termination drawing along with feeder termination details in Excel Sheet.
v) INV/UPS System Functional Description
w) Catalog

2.3 Along **with the materials being dispatched:** Bidder must send the following "**As Built & Approved"** status documents one (1) in soft copy & one (1) in hard copy.

(a) Instruction/O&M Manual
(b) Bill of Material
(c) Data Sheets
(d) Technical literatures/Catalogs
(e) Drawings GA/layout/wiring/interconnection/schematic, etc.

2.4 After dispatch of material within 1 week : Bidder must send the following **"As Built & Approved"** status documents one (1) in soft copy to BHEL-EDN.

(a) Instruction/O&M Manual
(b) Bill of Material
(c) Data Sheets
(d) Technical literatures/Catalogs
(e) Drawings GA/layout/wiring/interconnection/schematic, etc.

NOTE: One (01) set soft copy of Final document shall also be provided to BHEL. The soft copy shall be in CD-ROM media and shall in Acrobat (pdf) formats.

PROJECTS: THDC VISHNUGARH-PIPALKOTI HEP (4x111 MW)

TECHNICAL REQUIREMENTS

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Uninterruptible Power Supply (UPS) system including UPS Battery

GENERAL

The requirements of Electrical Power Supply system are specified herein on system basis. The bidder shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and owner approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Bidder whether these are specifically mentioned herein or not. All the equipment's and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works.

The Bidder shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the owner to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.

Bidder shall also provide local power supply distribution boxes on as required basis for sub-distribution of all 230V AC for various field mounted instruments/devices (e.g., Analyzers etc.). The power supply distribution box shall include necessary change over circuitry (as applicable), switch fuse units, MCB, terminal blocks, etc. suitable for the application. The sub distribution of feeders in a local power D.B shall be finalized during detailed engineering.

The UPS Power supply for various sub-systems shall consist of the following configuration.

Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to Owner's approval during detailed engineering.

Following general requirements shall be met for ensuring proper branch and circuit protection.

I. The feeder fuse ampere rating and feeder conductor capacity must be at least 100% of the non-continuous load plus 125% of the continuous load as calculated per Article 220 (220-10G) of NEC code - 1984. The feeder conductor must be protected by a fuse not greater than the conductor capacity.

II. For circuit with transformers requirements for conductor protection articles 240 and 310 of NEC must be observed. If secondary fuse protection is not provided then the primary fuses must not be sized larger than 125% of the transformer primary full-load amperes.

If secondary fuses are sized not greater than 125% of transformer secondary current, individual transformer fuses are not required in the primary provided the primary feeder fuses are not larger than 250% of the transformer rated primary current.

The minimum capacity of the UPS at load factor of 0.8 lagging at 50 deg C.

The UPS System shall meet the following requirements as a minimum.

1.0 If UPS KVA rating is applicable at a lower ambient temperature than specified 50°C the bidder shall consider a derating factor of at least 1.5%/°C for arriving at the specified UPS capacity at 50 deg C ambient. The UPS shall have an over load capacity of 125% rated capacity for 10 minutes and 150% rated capacity for 10 seconds. The inverter shall have sufficient I^2t capability to clear fault in the maximum rated branch circuit limited to 8 percent of finally selected UPS capacity.

2.0 Chargers

2.0.1 The chargers shall be self-regulating, solid state silicon controlled, full - wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimize harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Further more the charger should be able to re-charge the fully discharged battery within 8-10 hours. The charger output regulation shall be ±1% from no load to full load with an input power supply variation of ±10% in voltage and ±5% in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing Modbus TCP/IP Protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by owner during detailed engineering.

2.0.2 The charger shall be current limited for charger circuit protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The charger shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.

2.0.3 The chargers shall be served from a 415V, 50 Hz, 3 phase 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration.

2.0.4 The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/-2% of Charger Output Voltage.

2.0.5 The UPS battery shall have sufficient amp-hour capacity to supply the steady state kVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS.

2.0.6 The UPS shall be capable of operating without D.C battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch, etc. shall be guaranteed without the battery in circuit.

2.0.7 The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C battery.

3.0 STATIC INVERTER

The static inverter shall be continuous duty, solid state type using proven pulse width modulation (PWM) / Quasi square wave /step wave technique. Ferro-resonant type inverters are not acceptable. The nominal voltage output shall be 230 Volts, single phase, 50 Hz. The inverter equipment shall include all necessary circuitry and devices to confirm to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization, etc. The steady state voltage regulation shall be ± 2% and transient voltage regulation (on application/removal of 100% load) shall be ± 20%. Time to recover from transient to normal voltage shall not be more than 50 msec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronization limit for maintenance of synchronization between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1Hz.

4.0 Static Switch and Manual bypass switch:

The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (**i**) faulty inverter to healthy inverter in case of failure of one of the two inverters and (**ii**) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode.

Manual bypass switch shall be employed for isolating the UPS during maintenance

Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak capacity shall be 1000% of continuous rating for 5 cycles.

5.0 STEP DOWN TRANSFORMER & VOLTAGE STABILIZER

One 415V three phase to 230V, single phase transformer along with associated voltage stabilizer shall be furnished with each UPS system. The transformer and stabilizer combination shall convert owner furnished 415V +/- 10% three phase plant auxiliary AC supply to 230V +/- 2%, single phase standby AC power supply source.

The transformer shall be of low impedance air-cooled type and its kVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved.

The overload capacity of the transformer/stabilizer shall not be less than 300% for 200 ms duration. The voltage stabilizer shall employ servo controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabilizer shall be 95% or better.

6.0 AC Distribution Board (ACDB)

The details of the AC distribution board i.e., exact, rating and number of feeders, etc of 2x100% ACDB shall be as per attached feeder list.

7.0 BATTERIES- APPLICABLE

7.0.1 1 set lead acid 2V SMF VRLA Battery for 1 hrs backup

8.0 Auxiliary Equipment's

8.0.1 All required equipment's/materials shall be furnished with each rectifier bank, UPS & battery bank and shall include as a minimum various meters (AC/DC voltage/current, kVA, power factor, frequency meters etc.), circuit breakers, selector switches, push buttons indicating lights, ground detector system, battery accessories like (inter cell connectors, inter step connectors, battery racks, etc.). Isolated 4-20 mA signals for important parameters and potential free contacts for important alarms shall be provided for use in DCS.

9.0 Battery Racks

Two tier battery racks of mild steel construction in accordance with applicable codes and standard shall be provided. AISC specification shall apply in absence of another design specification. The batteries are to be mounted on insulated sub-frames with the necessary consoles and fixing material and these battery racks shall be designed to take care of corrosive environment.

10.0 CABINETS / ENCLOSURES

The construction details for power supply system Cabinets/ Enclosure / Racks shall conform to the requirements of the following.

(1) Equipment enclosures shall match and line up in assemblies of freestanding floor mounted cabinets designed for indoor service.
(2) Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6 mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches.
(3) Each assembly may be shipped in sections for ease of handling and field assembly. Terminal blocks shall be furnished as required adjacent to each shipping split to facilitate field assembly. Cable bundles cut to the required length and furnished with terminal lugs tagged for identification shall be provided for the wiring between shipping sections.
(4) Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings.
(5) The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg C above ambient temperature. The cabinets shall be **IP-32** protection class. Paint Thickness : Min 60 microns
(6) The color shade of panels exterior/interior shall be as per RAL 9002, end panel color shall be as per RAL 5012.
(7) Proper gland plates with suitable cutout to be provided for cabling and suitable glands & lugs are in the scope of INVERTER/UPS supplier. This will be finalized during detail engineering.

11.0 Cooling System

If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirements:

(a) Reserve cooling equipment shall be furnished for each switch board assembly. Reserve fan capacity shall be equal to 100 percent of cooling fan requirements for full load operation with only one bank of inverter/rectifier in service at the specified maximum ambient temperature.

(b) Completely independent duplicate wiring and control system shall be provided for the normal cooling fan system the reserve cooling fan system.

(c) Each cooling fan shall normally run continuously and shall be powered from the output of the inverter whose enclosure if serves (for cubicle housing inverters). Each cooling fan supply circuit shall be separately fused.

(d) Each cooling fan shall be equipped with an air low switch having an alarm contact that closes upon failure of air flow or rise of temperature.

12.0 BATTERY HEALTH MONITORING SYSTEM

BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24V DC systems & UPS battery banks on-line. With BHMS it shall be possible to measure & analyze the minimum and maximum voltage values of each battery cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the DCS and provide necessary alarms. **BHMS designed should be have enclosure of IP-32(Min), with all components housed in enclosure with option of mounting wall/floor. Bidder has to submit the MODBUS protocol details with mapping table of all the signals**.

OTHER POINTS: -

a) 4-20 mA Transducers for Output Voltage, Current & Frequency Transducers shall be provided in each limb of UPS System. If these transducers are provided in ACDB panel as per manufacturer standard, then these transducers should be provided in each ACDB.
b) Battery Current & Voltage transducers shall be provided.
c) Manual Discharge Resistor Bank of adequate Battery AH capacity shall be provided by the UPS Manufacturer for the project.
d) Fuses shall be provided for both Phase and Neutral line for each outgoing feeder in ACDB.
e) ACDB should have indicating lamps for each loads.
f) Battery Isolation box should have MCCB for isolation. Isolators are not acceptable.
g) Grounding details of all UPS, ACDB, BHMS, BAB should be shown by bidders along with cable size.

13.0 SITE TESTS

The Bidder shall also carry out the site tests on equipment's/systems as specified below. However, these shall not be limited to this specification only and in case any other site test is required to be conducted as a standard practice of Bidder or deemed necessary by the owner and mutually agreed between bidder and owner, the same shall also be carried out.

Functional Test

On completion of installation and commissioning of the equipment the following tests/checks shall be carried out with the maximum available load, which does not exceed the rated continuous load. These tests/checks shall include but not limited to the tests as indicated below. The details of the tests are as indicated below:

1. Light Load Test

This test is carried out to verify that the UPS is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked:

(a)Output voltage, frequency and the correct operation of meters;
(b)Operation of all control switches and other means to put units into operation.
(c)Functioning of protective and warning devices.
(d)Operation of remote signaling and remote control devices.

2. Checking of Auxiliary Devices

The functioning of auxiliary devices, such as lighting, cooling, pumps, fans annunciation, etc., should be checked, if convenient, in conjunction with the preliminary light load test.

3. Synchronization Test

If possible, frequency variation limits should be tested by use of a variable frequency generator, otherwise, by simulation of control circuit conditions. If applicable the rate of change of frequency during synchronization shall be measured.

4. A. C Input Failure Test

The test is performed with a fully charged battery and is carried out by tripping input circuit breakers or may be simulated by switching off all UPS rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope or equivalent. Frequency variation is defined as the steady state frequency of the UPS with and without AC input. The rate of change of frequency is measured by the time it takes to reach steady-state values.

5. A. C Input Return Test

AC input return test is performed by closing AC input circuit breakers, or is simulated by energizing rectifiers and bypass feeders.

Proper operation of rectifier starting and voltage and frequency variations are to be observed.

Note: This test is normally performed with a fully or partially charged battery.

6. Simulation of Parallel Redundant UPS Fault

This test is applicable for UPS with parallel redundant connections. Faults of rectifier or inverter units may be carried out by simulation. Output transients are to be observed.

7. Transfer Test

This test is applicable for UPS with bypass, particularly in the case of an electronic bypass switch. Transients shall be measured during load transfer to bypass caused by a simulated fault and load retransfer after clearing of the fault.

8. Full load test

Load tests are performed by connecting the actual load to the UPS output.
Large UPS in parallel connection may be load tested by testing the individual UPS units separately. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, temperature rise and determination of efficiency. Load tests are performed to prove, transient voltage deviations specified under step load conditions.

9. Efficiency

Efficiency should be determined by the measurement of the active power at input and output.

10. Actual Load Test

Conditions under actual load may differ from those with a dummy load. Steady-state generation of current and voltage harmonics and transients at load switching conditions should be observed.

11. Current Division in Parallel -

Load sharing between the Modular DC power supply rectifier banks & UPS units shall be measured with actual load under conditions of parallel operation.

12. Rated Stored Energy Time (Battery Test)

This test is a load test to prove the actual possible time of battery operation.
If rated load is not available in the case of large UPS, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer Discharge time with rated load- shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the UPS and the battery voltage shall be recorded during the test.
Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed.

13. Rated Restored Energy Time

Restored energy depends on the charging capacity of the rectifiers and the battery characteristics. If a certain recharging rate is specified, it shall be provided by repeating the discharge test after the specified charging period.

14. Battery Ripple Current

If battery ripple currents are specified, then the ripple current which depends on UPS operation shall be checked under normal operating conditions. Rough measuring methods are sufficient.

15. On Site Ventilation Test

The test is performed with the actual load. Temperatures conditions of all UPS cubicles are to be observed.

16. Overload Capability Test

Overload capability test is a load test. Specified values of short time overload or starting up sequences of actual load are to be applied for the time interval specified. Specifed values of voltage and current are to be recorded.

17. Short Circuit Current Capability

If short-circuit current capability is specified, it may be tested by applicable of a short circuit to UPS output if necessary, via suitable fuse, short circuit is to be recorded.

18. Short Circuit Fuse Test

Fuse tripping capability of a UPS shall be tested, by short-circuiting the UPS output via a fuse of specified type.

The test shall be repeated to ensure against fuse non-uniformity and switching time during the cycle. The test is carried out at an appropriate UPS load, under normal operation, if not otherwise specified by Owner.

19. Restart

Automatic or other restart means are to be tested after a completed shut-down of UPS as specified.

20. Output over voltage

Output over voltage protection is to be checked.

21. Periodic Output Voltage Modulation

When this test is specified, it may be checked by voltage recording at different loads and operating conditions.

22. Harmonic Conditions

Harmonic components of output voltage shall be checked with the actual load. Methods of specification and checking shall be subject to Owner's approval.

23. Earth Fault Test

If the UPS output is isolated from earth, then an earth fault can be applied to any output terminal. UPS output transients (if any) shall be measured.

If the battery is isolated from earth, then an earth fault can be applied to any output terminals. UPS output transient (if any) shall be measured.

PROJECT SPECIFIC TECHNICAL REQUIREMENTS

POWER SYSTEM

The following rated voltage and frequency levels will be available at the stations:

Voltage	Frequency	Description
240VAC±2%UPS	50Hz±2%	General-purpose single-phase supplies
240VAC±2%UPS	50Hz±1	Essential supplies
24VDC		Essential instruments / devices supplies

- An uninterruptible Rack Mounted Power Supply (UPS) shall provide the continuous power requirements for servers, telecommunications and related control devices.
- All fields supply shall be 240V AC with interrogative relays in the RIO panels for 24 volts DC modules.

POWER SUPPLY MODULE:

I. Power supply module shall be redundant and suitable to operate on 240V AC, 50Hz, and single phase from UPS. Failure of one power supply module shall not affect the process control. The module shall provide power supply to the processor, IO rack. Switchover due to power supply failure be bump less and automatic.

II. The bulk power supply modules shall work on hot redundant mode shall have a common output to feed to the processor, IO-system in such a way that in case of failure of one module, the other shall takeover without interruption of processor operation. Switchover between the bulk power supply modules shall be bump less and automatic.

III. The power supply module shall have LED for showing healthiness of the module. All modules shall have over-current and over-voltage protection. Suitable cooling arrangement shall be provided for each module to ensure their continuous operation.

SURGE PROTECTION DEVICE(SPD):

The lighting and surge protection devices shall comply with IEC 62305, BS EN 623050, DIN EN 61643-11, IEC60364-5-53. The SPD shall be tested as per recommendations of IEC 61643-1 Documentary proof to declare conformity to compliance with the international standards shall be submitted.

PROTECTION FOR UPS:

The power supply to the UPS shall be protected by suitable SPD for surge of 7KA of 10/350 microseconds for each phase to neutral and 25KA of 10/350 microsecond for neutral to earth. Additionally, phase to neutral shall be capable of handling surge of 30KA of 8/20 microseconds.

PROTECTION FOR INPUT-OUTPUT MODULES:

- Surge protection circuit shall be inbuilt into relay patch cards.
- Input-output modules shall be protected by suitable SPD for lighting surge of 4KA of 10/350 microseconds.

ACDB:

The UPS systems shall feed their related ACDB. Each ACDB shall be rated for 100% load; they shall be tie-connected with the UPS system working in 50% load-sharing mode.
The ACDB shall be equipped with all necessary circuit breakers, contactors, load-break switches, MCB, measuring instruments (V/A Hz), transducers, voltage monitoring devices and interface to DCS.
The control of the system shall guarantee safe AC supply at all operating conditions.

SHOP ASSEMBLY AND TESTS

General
All cubicle assemblies and their associated equipment shall be fully assembled and tested, witnessed by the Engineer, in the manufacturer's factory.
Each items of electrical equipment and all similar equipment supplied, as spare parts shall be given the tests listed below, to ensure successful operation of all parts of the assembly.
The factory test equipment and the test methods used shall conform to the recommendation of the relevant IEC Publication and shall be subject to approval of the engineer.

Cubical Assemblies

The Cubicle Assemblies Shall be tested in accordance with IEC Publication 60439:
Type test certificate of similar assembly of each type and routine test on all assemblies

Circuit Breakers
The circuit breakers shall be tested in accordance with IEC Publications 60947-1 and 60947-2:
Type test certificate of similar circuit breaker of each type shall be submitted by the contractor and routine tests shall be carried out on all circuit breakers.

Operational Test
All electrical equipment and installations shall be subject to a complete operational test to check the correct operational requirements specified in these Specifications.

Certificates
The Contractor shall submit suitable certificates of test made on equipment of the same type. However, the Engineer reserves the right to accept these certificates or to reject them partially or totally

TYPICAL BATTERY SIZING CALCULATION FOR UPS

Battery sizing calculation for UPS System:

Full load of UPS = **'A'** kVA

Max. Output load on UPS in watts = **'A'** x 1000 x 0.8 (P.F)

= **'B'** Watts

Inverter efficiency = 0.90 minimum
Type of Battery and Back up Time required = Lead Acid SMF VRLA, 100% load for 1hr
End cell voltage (ECV) = 1.75 Volts/cell.
Number of cells = 180 cells
Ageing factor = 1.25
Design Margin = 1.25

Temperature correction factor (at 25 deg. C) = '**C**' say

Capacity Factor at ECV of 1.75V for 1hr back-up, K = '**D**' say

Then Battery Discharge Current required $= \dfrac{\text{'B'}}{1.75 \times 0.90 \times 180}$ = **'E'** Amps

AH required = **'E'** x '**D**' = '**F**' say

Total Discharge Current considering the factors such as temperature correction factor, design margin & ageing factor is

= '**F**' x '**C**'x 1.25 x 1.25 = 'Z' say

Battery AH to an End Cell Voltage of 1.75V/cell and suiting the above discharge current = '**Y**' say

Hence, Battery selected = **180 cells of 'Y' AH which can deliver 'Z' Amps for 1hr back-up at ECV=1.75V/cell.**

1.0 GENERAL TECHNICAL REQUIREMENTS OF VRLA BATTERY

a) General

i.) Each set of battery shall consist of number of cells assembled together on mounting racks.

ii.) The battery shall be Valve Regulated Lead Acid (VRLA) maintenance free batteries. Each battery set will have sufficient capacity to maintain output at full rated load. The battery in normal case is not allowed to discharge beyond 80% of rated capacity at 10 hrs rate of discharge.

iii.) The battery sets will meet the requirement of IS 15549 and will be suitable for continuous operation. The batteries will be suitable for float/boost charging.

b) Constructional Requirement

The design of battery will be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity will not be permitted. Protective transparent front covers with each module will be provided to prevent accidentally contact with live modules / electrical connections.

c) Container

Each cell will be assembled in heat resistant, acid resistant, shock absorbing robust, clear glass or lead lined wooden container having chemical and electro-chemical compatibility. The material will meet all the requirements of VRLA batteries and be consistent with the life of the battery. The container will be fire retardant. The porosity of the container will be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container will be such as to handle the internal cell pressure of the cells in the worst working conditions. The container will be capable of withstanding the rigours of transport, storage and handling.

d) Cell covers

The cell covers will be made of suitable compatible with the container material and permanently fixed with the container it will be fire retardant. Fixing of Pressure Regulated Valve terminal posts in the cover will be such that the seepage of electrolyte gas escapes and entry of electro static spark are prevented.

e) Plates

Positive grid will be of pure lead calcium tin alloys and maintenance free characteristics. Positive plate will be free from cadmium. The positive & negative plates will be flat pasted.
Both positive & negative plates will be tanked formed to ensure that plates are fully formed.

f) Grid Growth Provision

This Provision should be made in the cell design to prevent failure due to internal shorting / rupture of cell because of grid growth

g) Separators
The separators cells will be glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. Proper arrangement to keep the separator plates in position will be furnished.

h) Pressure Regulating Valve
Each cell will be provided with a pressure-regulating valve. The valves will be self re-sealable and flame retardant. The valve unit will be such that it cannot be opened without a proper tool. The valve will be capable to withstand the internal cell pressure specified by the manufacturer.

i) Terminal Posts
Both the positive and the negative terminals of the cells will be capable of proper termination and will ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole will be coated with an acid resistant and corrosion and retarding material. Terminal posts of any other metal part, which is in contact with electrolyte, will be made of same alloy as that of the plates or of a proven material that does not have any harmful effects on cell performance. Both positive and negative posts will be clearly and unambiguously identifiable.

j) Connectors, Nuts, Bolts, Heat Shrinkable Sleeves
Nuts and bolts for connecting the cells will be made of copper, brass or stainless steel. Copper or brass nuts and bolts will be lead coated. Wherever required separate non-corroding lead or copper connectors of suitable size will be provided to enable connection of the cells. Copper connections will be suitable lead coated to withstand corrosion due to sulphuric acid.
All inter cell connectors will be protected with heat shrinkable silicon sleeves for reducing environmental impact including a corrosive environment.

k) Flame Arrestors
Each cell will be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge.

l) Battery bank stand and Cell Orientation
All batteries will be mounted in a suitable metallic tray/ frame. Cells will be housed in a ventilated & protected modular steel tray to facilitate airflow between the cells. The partitions will have grooves to facilitate airflow. The steel tray will have partitions for each cells to maintain consistent compression & single cell replacement. The steel trays will be powder coated for acid resistance. The cell orientation in the steel trays will be horizontal (i.e. the positive & negative plates should be parallel to ground).

m) Capacity Requirements
The battery will be capable to deliver the rated load of the UPS for 240 minutes. When the battery is discharged at 8 hours rate, it will deliver 80% of the rated capacity corrected at 27 deg C before any of the cells in the battery bank reaches 1.75V / Cell.

3.0 BATTERY ACCESSORIES

Each set of battery shall be equipped with fittings and accessories as listed below.

1. One battery log book.
2. Two copies of printed instruction sheet.
3. One no. cell testing voltmeter (3-0-3 volts) complete with leads.
4. Insulator (with 5% extra), rubber pad etc. for rack
5. One pair of spanners.
6. One set of inter cell, inter tier and inter bank connectors as required for complete installation.
7. Self adhesive PVC stickers for cell numberings.
8. Goggles.

Any other accessories if required for satisfactory operation of the complete battery system shall also be included in Bidder's offer and to be supplied accordingly.

4.0 TESTS

AH Capacity Test

FEEDER LIST

NOTE: Feeder list subject to change during detail design.

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

BHEL	Feeder list for UPS VISHNUGAD PIPALKOTI (4X 111 MW) HEP	416/UPS/PIPALKOTI REV.NO.3 Page 1 to 3

ACCEPTED AS INFORMATION

जाँची गई
CHECKED

22/8/25

संस्तुत
RECOMMENDED

शैलेन्द्र सिंह पंवार
SHAILENDRA SINGH PANWAR
अपरमहाप्रबंधक (विद्युत यांत्रिकी-परिकल्प)
Addl. General Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC INDIA LIMITED, RISHIKESH

22/8/25
आर. आर. सेमवाल
R. R. Semwal
मुख्य महाप्रबंधक (विद्युत-परिकल्प)
CGM (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC INDIA Ltd., Rishikesh

PROJECT NAME : VISHNUGAD PIPALKOTI (4X 111 MW) HEP

PRODUCT : UPS SYSTEM

CUSTOMER : M/S THDC

BHEL Document No : EDN-416-UPS-010

	BHEL BHARAT HEAVY ELECTRONICS LTD. EDN, BANGLORE		Feeder List	
	Prepared:	AB		
	Verified:	AKS		REV.NO:3
	Issued:	CE-BPE		
	Date:	21/08/2025		

REV NO	DATE	NATURE OF CHANGE	REASON	PREPARED BY	VERIFIED BY
00	05/05/2025	FIRT ISSUE	-	AB	AKS
01	25/07/2025	SECOND ISSUE	As per M/s THDC comments	AB	AKS
02	06/08/2025	SECOND ISSUE	As per M/s THDC comments	AB	AKS
03	21/08/2025	THIRD ISSUE	As per M/s THDC comments	AB	AKS

Project: M/s THDC VISHNUGAD PIPALKOTI (4X 111 MW) HEP

S.NO	FEEDER DESCRIPTION	NO. OF FEEDERS ACDB-1	NO. OF FEEDERS ACDB-2	FEEDER RATING IN AMPS	kVA RATING OF EACH FEEDER	TOTAL KVA	MCB RATING (in Amps)	FUSE RATING (in Amps)
1	UCB (ASE) Unit-1	1	0	4.00	0.64	0.64	6	10
2	UCB (ASE) Unit-2	0	1	4.00	0.64	0.64	6	10
3	UCB (ASE) Unit-3	1	0	4.00	0.64	0.64	6	10
4	UCB (ASE) Unit-4	0	1	4.00	0.64	0.64	6	10
5	LCB for Common Station Services	0	1	4.00	0.74	0.74	6	10
6	LCB for 420KV Switchyard	1	0	6.30	1.01	1.01	6	10
7	Master Slave Clock System	1	1	4.34	1.00	1.00	6	10
8	Station Process Control panel	1	0	4.00	0.92	0.92	6	10
9	EHGC Unit#1	1	0	6.30	1.16	1.16	6	10
10	EHGC Unit#2	0	1	6.30	1.16	1.16	6	10
11	EHGC Unit#3	1	0	6.30	1.16	1.16	6	10
12	EHGC Unit#4	0	1	6.30	1.16	1.16	6	10
13	Main Fire Alarm Panel-1	1	1		1.00	1.00	6	10
14	Repeater Panel-1	1	0		0.25	0.25	6	10
15	Operator Work Station-1	0	1		0.50	0.50	6	10
16	PLC for FPS	1	1		5.00	5.00	6	10
17	Power Supply unit-1	1	0		0.25	0.25	6	10
18	Power Supply unit-2	0	1		0.25	0.25	6	10
19	Power Supply unit-3 &4	1	0		0.25	0.25	6	10
20	Power Supply unit-5	0	1		0.25	0.25	6	10
23	Instrument Panel	1	0	4.00	0.64	0.64	6	10
24	Temperature Measurment Panel	0	1	4.00	0.64	0.64	6	10
28	HVAC SCADA HMI	0	1	1.50	0.35	0.35	6	10
29	Network Panel for DCS & HMI (NWPC01)	1	0	23.00	5.29	5.29	25	32
		0	1	23.00	5.29	5.29	25	32
30	DAVR Measuring Ckt,Protection Relays UNIT-1	1	1	4.00	1.29	1.29	6	10
31	DAVR Measuring Ckt,Protection Relays UNIT-2	1	1	4.00	1.29	1.29	6	10
32	DAVR Measuring Ckt,Protection Relays UNIT-3	1	1	4.00	1.29	1.29	6	10
33	DAVR Measuring Ckt,Protection Relays UNIT-4	1	1	4.00	1.29	1.29	6	10
	TOTAL LOAD					**36.00**		

Total Load = 36.00 kVA
Total Load + 25% Spare = 45.00 kVA
UPS Rating = 45 kVA

S.NO	FEEDER RATING MCB / FUSE	NO OF FEEDERS IN ACDB-1	NO OF FEEDERS IN ACDB-2	CONSIDERING 20% SPARE ACDB-1	CONSIDERING 20% SPARE ACDB-2
1	6A/10A	17	17	21	21
2	25A/32A	1	1	2	2
	TOTAL	**18**	**18**	**23**	**23**

Note:

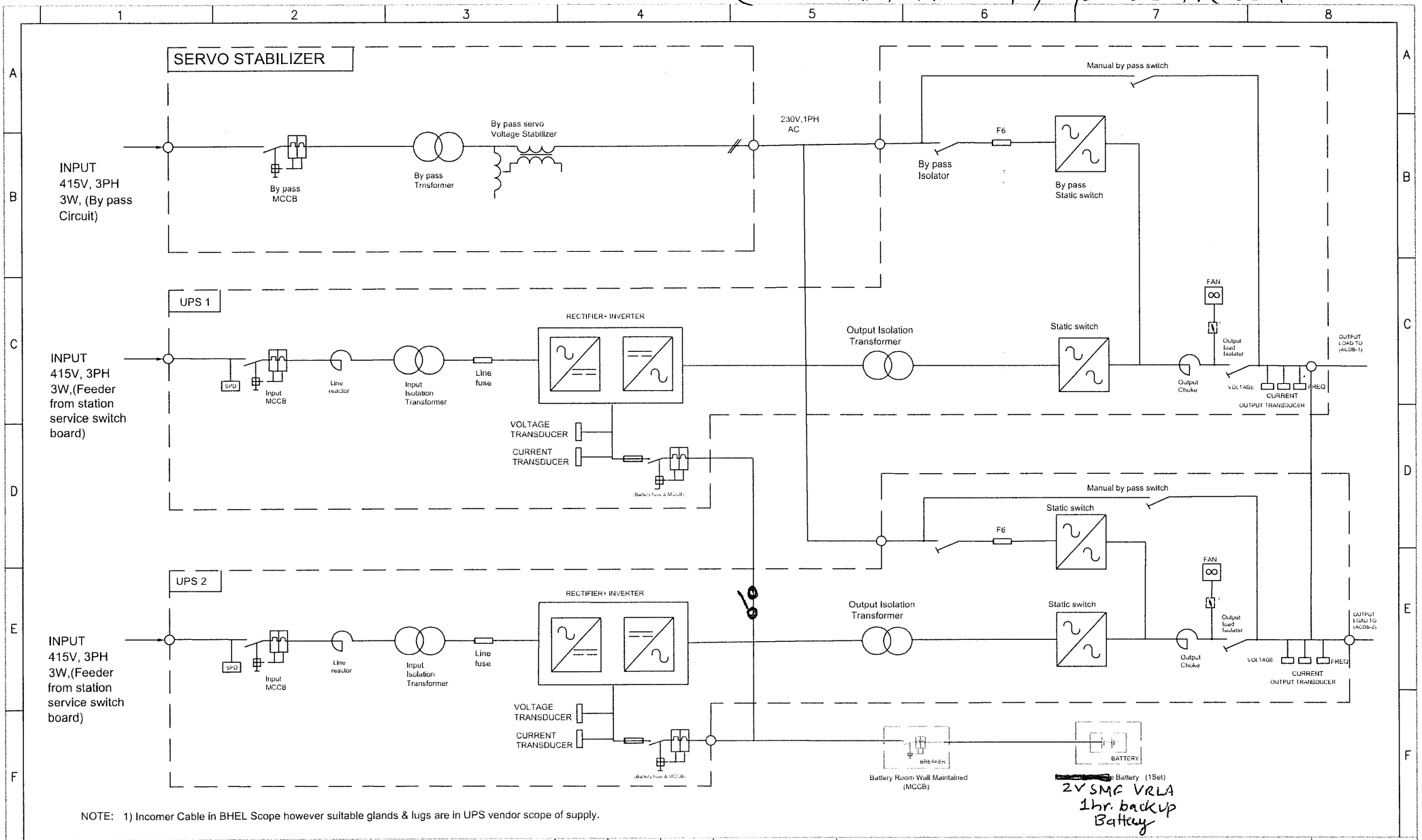
1.) UPS rating is 2 x 45 kVA at 50 deg C

2) Suitable loading factors for each loads are considered in arriving the UPS rating along with design aspect of efficiency of UPS system

3) UPS system consist of 2x100% inverter,along with bypass & 2x100% ACDB along with 1 set of common 2V VRLA SMF BATTERY 1HR BACKUP

SINGLE LINE DIAGRAM

UPS SLD FOR (VISHNUGARH - PIPALKOTI) M/S THDC PROJECT



NOTE: 1) Incomer Cable in BHEL Scope however suitable glands & lugs are in UPS vendor scope of supply.

REV.	DATE	ALTERED / CHECKED / APPROVED	REV.	DATE	ALTERED / CHECKED / APPROVED

	NAME	SIGN.	DATE
DRAWN	SYED OWAISE		28.03.25
CHECKED			28.03.25
APPROVED			28.03.25

DEPT	CODE
ENGG	416

BHARAT HEAVY ELECTRICALS LIMITED
ELECTRONICS DIVISION, BANGALORE

CARD CODE

TITLE : UPS Scheme for [redacted] UPS SYSTEM

General scheme for UPS System [redacted]

WBS No.

DRG. No.

No. OF SHEETS	1
SHEET No.	1
REV.	0

SIZE A3