

DELHI METRO RAIL CORPORATION LIMITED

Contract: OTW-1285: “Supply, Installation, Testing and Commissioning of 200 kVA UPS at BCC SHPK”.

Addendum No.2

Summary Sheet

S. No.	Tender Document	Page No.	Clause No. / Item No.	Addendum / Corrigendum	Remarks
1	Notice Inviting Tender	3 of 14	1.1.2 h	Last date of issuing amendment	Replace page 3R of 14 with <u>3R</u> of 14
2	Employer Requirement	8 of 19	clause 3.2.1 (f)	Clause is modified	Replace page 8 of 19 with <u>8R</u> of 19
3	Technical Specifications	All Pages	Not Applicable	There are 22 pages in the Technical Specifications. Therefore wherever page number '23' of Technical Specifications is mentioned it shall be read as page number '22'.	
4	Technical Specifications	2 of 23	1.1.2	Typo error corrected	Replace page 2 of 23 with <u>2R</u> of 23
5	Technical Specifications	3 of 23	1.2.4.ii.12, 1.2.4.iii, 1.2.4.v & 1.2.4.viii	Typo error corrected in all	Replace page 3 of 23 with <u>3R</u> of 23
6	Technical Specifications	4 of 23	1.2.5.c.v & 1.2.5.f	Typo error corrected in all	Replace page 4 of 23 with <u>4R</u> of 23
7	Technical Specifications	5 of 23	1.2.5.j.iv & 1.2.6	Typo error corrected in 1.2.3.j.iv & Grammatical error corrected in 1.2.6	Replace page 5 of 23 with <u>5R</u> of 23
8	Technical Specifications	6 of 23	1.2.7.3, 1.2.7.7, 1.2.8.1, 1.2.8.2 & 1.2.8.3	Typo error corrected in 1.2.7.3, 1.2.7.7, 1.2.8.1 & 1.2.8.3 , Clause 1.2.8.2 is Deleted	Replace page 6 of 23 with <u>6R</u> of 23
9	Technical Specifications	7 of 23	1.2.8.3 & 1.2.9	Typo error corrected in 1.2.8.3, Formatting error corrected in 1.2.8.3.	Replace page 7 of 23 with <u>7R</u> of 23
10	Technical Specifications	8 of 23	1.2.12.l	Typo error corrected	Replace page 8 of 23 with <u>8R</u> of 23
11	Technical Specifications	9 of 23	1.2.17.d	Typo error corrected	Replace page 9 of 23 with <u>9R</u> of 23
12	Technical Specifications	11 of 23	1.4.4 & 1.5.5.a	Typo error corrected in both	Replace page 11 of 23 with <u>11R</u> of 23

g.	Pre-bid Meeting	14.02.2023at 11:00Hrs. The pre bid meeting shall be conducted through video conferencing by software apps such as Cisco Webex, Microsoft Teams etc. All Prospective bidder shall provide the details of the person(s) (maximum up to two) who will be participating in such virtual meeting at least 24 hours before the meeting (latest by 11:00Hrs. on13.02.2023) to the registered email of DMRC i.e. cetenderonm@dmrc.org , so that link having details such as software, meeting ID, password etc. can be mailed to these person preferably 12 hours before the scheduled pre-bid meeting.			
h.	Last date of issuing amendment, if any	23.02.2023 <u>24.02.2023</u>			
i.(i)	Tender submission Start Date and Time (online)	02.03.2023 (from 09:00Hrs.)			
i.(ii)	Tender submission end Date and Time (online)	09.03.2023(Upto14:00Hrs.)			
j.	Date & Time of opening of Tender (Technical Bid) (online)	10.03.2023at 14:30 Hrs.			
k.	Date & Time of opening of Financial Bid	Will be informed later on after the evaluation of Technical bids (Only to the bidders who will successfully qualify the Technical Evaluation)			
l.	Validity of Tender	180 days from the last date of submission of tender.			
m.	Stipulated date of Commencement of work	Within seven days from the date of issue of “Letter of Acceptance” or as per the instructions of Engineer.			
n.	Completion Period	04 (Four) Months			
o.	Authority and place for submission of tender cost, tender security&required documents (if any) and seeking clarifications on tender documents	CE/Tender (O&M), Delhi Metro Rail Corporation Ltd., 5th Floor, C-Wing, Metro Bhawan, Fire Brigade Lane, Barakhamba Road, New Delhi –110001			
p.	To facilitate payment of Tender Fee and Tender Security through RTGS, NEFT & IMPS, the details of bank account of DMRC is mentioned below:				
Name of Bank		Bank’s Address	Account Name & No.	AccountType	IFSC code
Punjab National Bank		ECE House Branch, Connaught Place, New Delhi -110001	DMRC Ltd. O&M Expenditure A/C, 1120005800000032	Current	PUNB0112000

1.2 QUALIFICATION CRITERIA

1.2.1 Eligible Applicant

- i. The tenders for this contract will be considered only from those tenderers (proprietorship firms, partnership firms, companies, corporations, consortia or joint ventures) who meet requisite eligibility criteria prescribed in the sub-clauses of Clause 1.2 of NIT. In the case of a JV or Consortium, all members of the Group shall be jointly and severally liable for the performance of whole contract. Also, each member shall be individually responsible for its duties as specified in the MOU/JV agreement submitted by the bidder in terms of clause 1.2.1 vii(d).

Performance of each JV/Consortium partner shall also be judged on quarterly basis. In case, the performance of the partner(s) is not found satisfactory, actions as deemed appropriate by the Employer may be taken including termination of contract or termination of any of JV/Consortium member(s) from the contract i.e. Part Termination of the contract. In case of part termination of contract, the Performance Security(ies) submitted by the member(s) for their portion of work in contract as per their share in JV/Consortium shall be forfeited and the scope of the work/duties assigned to the defaulting JV/Consortium member(s) as per the MOU/agreement submitted, may be terminated, however, same may be done by the Employer only if other member(s) of JV/Consortium are ready to complete the entire scope of work. In

1.4 Employers Drawings

- 1.4.1 Employer's drawings consist of UPS (S&T) Room Layout, showing the trench location, Equipment (cubicle), and other necessary requirements to facilitate the operations of complete UPS and its allied Systems.
- 1.4.2 The Employer's Drawings assist in describing the scope of the Works in general and clarify constraints, interface arrangements and the conceptual nature of the system outline.

1.5 Work Programme

- 1.5.1 Work programme shall be developed and submitted to the employer to explain the design, manufacturing, installation, testing & commissioning and training activities.

2. OVERVIEW OF THE PROJECT

2.1 General

- 2.1.1 A 200 KVA UPS system complete in online redundant configuration along with two sets of battery bank is required at Backup Control Centre- Shastri Park to supply power to central equipment of Telecom-AFC, SCADA and Signaling departments. The UPS system includes provision of MCCBs for various departments as per Annexure III.

3. SCOPE OF THE WORKS, SUPPLY AND SERVICES

3.1 General

- 3.1.1 The scope of the works includes but not limited to supply, manufacture, inspection, packing, shipping, transportation, storage, delivery, handling, insurance, installation, interfacing, integration, testing & commissioning, special tools required for execution of works, test equipment, training, documentation and providing DLP for the UPS system.

3.2 Scope of Supply

- 3.2.1 The Uninterruptible Power Supply (UPS) system shall include, but not be limited to the following:
- a) Online redundant UPS;
 - b) Battery bank;
 - c) Spare cell charger;
 - d) Isolation Transformer Cubicle
 - e) SCVS;
 - f) ~~Built in Output Isolation Transformer in UPS System including bypass path~~
Inverter Output Isolation Transformer (transformer shall be placed between inverter output and static bypass switch);
 - g) Equipment cabinets, racks & cubicles;
 - h) AC Distribution boxes;
 - i) Cable trays/Trenches/Supports/Foundations;
 - j) ATS (Automatic Transfer Switch);

TECHNICAL REQUIREMENTS

1.1 General

The UPS and their constituent parts shall comply with the relevant latest version of British Standards (BS), European Standard (EN), International Electromechanical Commission (IEC) standards, International Organization for Standardization (ISO) Standards, Research Designs and Standards Organization (RDSO), Indian Railways Specifications (IRS) Standards as specified in clause 1.3.1.

1.1.1 Provision of suitable earth leakage detection both for DC and AC supplies and alarms shall be made individually.

1.1.2 The UPS and the battery backup system for S&TC and Telecommunication system shall include 2 numbers 3-phase Output, N, PE (TN-S) UPS in online redundant configuration powered by Two separate Battery Banks (one for each UPS), a stand by spare cell charger (for 1 to 6 UPS cells) and a spare cell bank with 6 numbers of cells. The backup is planned for a period of one hour for Telecommunication, S&TC & AFC equipment etc. The Battery Back-up time shall be tested for one hour (1 Hr) by each battery bank at full rating of associated UPS set.

1.1.3 The transformer insulation class shall be in accordance with heat they are likely to generate but in no case the insulation class shall be worse than Class H insulation. The Contractor shall submit detailed calculations to substantiate his design.

1.2 Equipment Design of UPS (415V AC 3 phase)

1.2.1 The UPS shall include rectifier, battery, charger, inverter, solid-state bypass switch and Servo Controlled Voltage Stabilizer in bypass path. Failure of a single component shall not cause failure of the total UPS. The UPS shall be of the self-contained floor mounted, bottom entry, metal-clad type with front access.

1.2.2 The UPS shall be designed such that on restoration of the 415 V AC 3 phase input supply source after its failure, the load shall be transferred on to this input source only after a delay and verification that there are no spikes and that the voltage has stabilized.

1.2.3 Two independent redundant 3-phase primary power input feeder cables will be made available inside the UPS Room to the contractor by DMRC.

1.2.4 Rectifier/Charger

- i. The input of the rectifier / charger shall be protected suitably.
- ii. The UPS shall have solid state PWM converter with IGBT rectifiers. The rectifier should have the following important features:

1. Power Conversion
2. Battery Charging
3. Power Factor Improvement
4. Current Harmonic Reduction
5. Voltage Regulation
6. Transient Recovery

7. Automatic Synchronization
 8. Over-current Protection
 9. Over Temperature Protection
 10. Control Power Failure Protection
 11. Short Circuit Protection
 12. Current limiting function of battery charging to prevent the battery ~~from being~~ **from being** damaged.
- iii. The rectifier / battery charger shall provide a regulated DC output for the inverter and the battery. The rectifier/charger regulation shall ensure that the DC output voltage fluctuations are less than 1% of rated value, irrespective of load and mains supply ~~voltage variations~~ **voltage variations**.
- iv. The rectifier / charger shall be equipped with a filter limiting the DC ripple voltage to a value less than 1% of the DC voltage.
- v. The rectifier / charger shall have sufficient capacity to enable simultaneous ~~supplying of~~ **supplying of** full load to the inverter and recharging a fully discharged battery to more than 90% of rated value within 10 hours. Detailed calculation sheet for rating of the rectifier arrived at considering UPS load requirement as well as battery charging requirement, shall be provided. Minimum charger current 0.1C, C being Battery bank capacity in Ah.
- vi. A protective circuit shall be provided to prevent battery overcharge. After the rectifier / charger has recharged the battery to 100% capacity, the rectifier / charger shall float charge the battery.
- vii. Provision shall be made to prevent the battery from over-charging due to battery charger rectifier fault. An adjustable battery current limiting device shall limit the battery recharge current to the maximum value recommended by the battery manufacturer. The rectifier/charger shall be electronically current limited to protect the connections to the Inverter input and to prevent damage to the battery.
- viii. The battery low-volt cut-off shall be set to suit the battery manufacturer's ~~recommendation to~~ **recommendation to** ensure the battery is not damaged by a deep discharge.
- ix. The rectifier/charger unit shall be equipped with an over-voltage protection device.

1.2.5 Battery System

- a. Storage battery banks shall be provided for the UPS with sufficient ampere- hour capacity to maintain the UPS output at the rated output capacity at BCC Shastri Park.
- b. The overall capacity of the battery system shall be such as to meet the specified performance and technical requirements throughout the life of the battery. The battery cell shall be of 2V, heavy duty, rechargeable, valve regulated lead acid and maintenance- free type and the performance shall comply with BS 6290: Part 4, IEC 60896 -21 & 22, BS 60896 -21 & 22 having an intended design life of at least 10 years. The battery shall be of reputed

make and manufactured in India.

- c. The battery bank shall be protected from internal fault by a circuit breaker. The UPS shall be automatically disconnected from the battery bank when the discharge limits of volts per cell are reached, or when signaled by other control functions. The battery circuit breaker installed at the battery room should be complete with a metal enclosure conforming to an Ingress Protection Classification of IP 54.
 - i. The battery shall be supplied with:
 - ii. Inter-cell connectors and terminals which shall be of high conductivity and shall be enclosed with insulated corrosion-free material.
 - iii. A cabinet or mild steel rack for shelving the batteries. The rack shall be designed to provide easy access to all components for maintenance and to minimize floor space requirements.
 - iv. Special tools and fittings required to assemble the batteries.
 - v. Battery storage cabinets or racks shall be insulated from the floor to achieve ~~the electrical~~ **the electrical** insulation for a minimum voltage of 5 kV.
- d. Temperature monitoring equipment shall be incorporated in the UPS system to optimize the charger voltage as a function of battery room temperature, to generate alarm in ~~case of~~ **case of** room temperature exceeding the preset permissible temperature and to predict the battery backup time.
- e. The rectifier/charger shall follow recommendation of battery manufacturer for battery recharge. It shall also be equipped with facilities to carry out in-situ tests for battery(full and partial) discharge.
- f. The battery shall be contained within the impact resistance flame retardant polypropylene cases with the cells being arranged in tiers to enable a rapid visual check. Terminal shall be shrouded to prevent accidental contacts. The battery enclosure shall ~~be corrosion~~ **be corrosion** resistant and ventilated.
- g. The standard battery operating temperature shall be of 25 °C. When the ambient air temperature exceeds 25 °C, the charging voltage shall be reduced to prevent overcharge and increased, as the temperature falls, to avoid undercharge.
- h. The battery stand shall be constructed to give maximum support to the cells. The stand shall be equipped with a means of levelling.
- i. Unless otherwise specified, all stationary batteries shall be of the Sealed Maintenance Free, Valve Regulated, Lead Acid type conforming to IEC 60896-21 & 22, BS 60896 - 21 & 22, RDSO specification No. IRS S93 – 96 with Amendment 1 or latest for battery capacities upto and including 500AH and to

IEC 60896- 21 & 22, BS 60896- 21 & 22, TEC specification No. TQ 510G 92 or latest for capacities above 500AH, if required. The capacity in ampere - hour (AH) shall be at 10-hour rate.

- j. The battery shall consist of VRLA (maintenance free) cells. The battery banks for the UPS shall be so organized that:
 - i. One set shall normally function to take up the entire load of UPS.
 - ii. The cells shall be grouped such that touch voltage does not exceed 72 V.
 - iii. Battery Back-up time is minimum one hour (1Hr) by each battery Bank at full rated load of associated UPS set. Battery sizing calculations shall be done as per the recommendations of IEEE-485 (2010) or latest, considering the following factors/margin:
 - a. Design margin of 10%.
 - b. Temperature correction factor assume at an ambient temperature of 27°C.
 - c. Ageing de-rating factor of 25% shall be taken into account.
 - d. Power factor of 0.8.
 - iv. A separate set shall consist of six cell blocks each of the same voltage as in the main battery bank. This set shall be maintained on charge from the charging unit such that one or more units from this set can replace faulty cell blocks of ~~the working~~ the working battery bank.
 - v. The contractor shall demonstrate the full load test for one hour after installation of UPS & Battery system for acceptance at BCC Shastri Park. For conducting the load test, all necessary load shall be arranged by the contractor itself.
 - vi. The contractor shall provide maintenance schedule of UPS system including battery bank, detailed battery bank load test procedure to monitor the health status of battery cells including the treatment of weak cell, if any and replacement procedure.

1.2.6 Battery Circuit Breaker (BCB)

Batteries shall be mounted on racks to allow access to all terminals. In reaching the terminals, maintenance staff shall not be required to stretch unduly over other batteries, with the risk of shorting battery terminals. A localized battery circuit breaker shall be provided for each battery bank. There should be provisions of status monitoring of all localised ~~all~~ battery circuit breakers at Central Monitoring Systems.

1.2.7 Inverter

- 1. The inverter shall be a solid- state device with proven Pulse Width Modulation technique utilizing Insulated Gate Bipolar Transistors and microprocessor controls, capable of accepting the output of the rectifier / charger or the battery system and provide a 3-phase alternating current output complying with the performance requirements.

2. The inverter shall utilize the latest and reliable technology to achieve high efficiency and reliability, and to cope with non-linear loads. The inverter should incorporate following essential features:
 - a) Voltage Regulation
 - b) Transient Recovery
 - c) Automatic Synchronization
 - d) Over-current Protection
 - e) Over Temperature Protection
 - f) Short Circuit Power Protection
 - g) Frequency Control
 - h) Inverter Output voltage Harmonic distortion
 - i) Inverter Overload protection
3. The inverter shall be capable to supply its rated load at power factor of at least 0.9 ~~leading or~~ **leading or** lagging.
4. Voltage harmonic distortion: The inverter shall provide sine wave output having harmonic neutralization and filtering to limit the total harmonic distortion on the output voltage to less than 1% of linear load and 5% of non-linear load.
5. Each inverter leg shall be protected from over-current to prevent damage to the solid-state devices in the inverter bridges.
6. The inverter output shall be electronically current limited.
7. The inverter shall be protected against over voltage and under voltage surges ~~introduced at~~ **introduced at** the output of the uninterruptible supply system by load switching and transfer to the bypass. If the bypass AC line deviates by more than 50 Hz $\pm$ 1% the inverter logic shall automatically revert to 50 Hz $\pm$ 0.25% and initiate an alarm condition.

1.2.8 Automatic Static Bypass Switch

1. The UPS shall be provided with a static By-pass switch. In the case of inverter failure, sub-circuit failure, load start-up inrush or battery capacity being exhausted upon rectifier/ **charger supply down, the static bypass switch shall transfer the load to the mains automatically within 4 milli-seconds. Full protection discrimination shall be achieved on the bypass circuit. In case of a single sub-circuit fault, the capacity of the static by-pass switch shall withstand the fault energy until the protective device of the sub-circuit clear the fault.**
2. **Deleted**
3. The means of operation shall ensure a make-before-break uninterrupted transfer of load ~~to~~ **load to** or from the by-pass supply source under both automatic and manual mode of operation. The static switch should also conform to the following minimum requirements:

Continuous Capacity Equal to the 100% continuous rating of the **inverter**
~~Inverter~~ Overload capacity Equivalent to the overload characteristics **of the UPS**
~~of the UPS~~

1.2.9 The following data shall apply to UPS (of complete system unless specified otherwise):

Output capacity (KVA) of each UPS	200 KVA for BCC Shastri Park
Input voltage (Three phase) of input feeder	415V AC +10%, - 20% #
Input frequency of input feeder	50 Hz, +/- 5%
Input Power factor	> 0.95
Output voltage	415V AC Three phase
Output frequency	50 Hz, +/- 1% (except in bypass)
Voltage Regulation: Static	Better than +/-1%
Dynamic (0-100-0% Load Step)	Better than +/- 3%
Overload capacity of each UPS	≥ 150 % for 60 seconds ≥ 125 % for 10 minutes ≥ 110 % for 60 minutes
a. Total Current Harmonic Distortion of each UPS at input (THDi)	< 3 %
b. Total Voltage Harmonic distortion of each UPS output	< 1% for 100% linear load <5% for 100% non-linear load
Crest factor of each UPS	≤ 3:1
Ambient Operating temperature	0-50 degree C (see clause 4.8.1)
Storage temperature	0 to + 70 degree C
Relative humidity (non condensing)	Up to 95% at 40°C
Efficiency (AC-AC) of complete system (including input and output transformers)	Better than 90% (From 25%load to full load)
Inverter efficiency (including output transformer)	Better than 0.95
Ripple content: With Battery	< 1%
Without Battery	< 2%
Battery Charging by each UPS in Boost Charging	C/10 rate
Battery Charging Characteristics and Charging Voltage	In accordance with VRLA batteryspecifications <u>battery specifications</u>

Source of power is from RSS/ASS which supplies Traction as well as Auxiliary loads of Metro Operations.

1.2.10 The UPS shall comprise of the following controls and protection:

- a) Emergency power off
- b) Maintenance bypass isolator

- c) Battery Isolator
- d) Low battery shutdown and trip.
- e) DC over-voltage.
- f) Charger current limit
- g) Thermal protection
- h) Ambient temperature protection
- i) Phase Sequence Protection
- j) Suitable alarm interface
- k) Remote monitoring with state of art technology & licensed version.
- l) Surge & Transient Protection device at input and output.

1.2.11 The UPS shall offer at least the following facilities:

- a) Maintenance log
- b) Alarm contacts
- c) Communication port
- d) Diagnostics and self-testing

1.2.12 The UPS system shall have at least the following displays/Alarms at local and Central monitoring Systems:

- a) Rectifier input voltage & current
- b) Bypass input voltage and current
- c) Inverter output voltage and current
- d) DC bus voltage
- e) Output frequency
- f) Available battery backup time at running load.
- g) Ambient temperature
- h) Load on Main Source
- i) Load on Standby Source
- j) UPS in service
- k) System in Bypass mode / UPS failed
- l) Normal UPS Supply available for Telecom, S&TC, AFC, E&M & PSD/PSG systems **PSG systems** .
- m) Status of various MCCBs of Input panel and output ACDB at remote location.

1.2.13 Alarms, health status & displays generated by each UPS shall be shown locally, as well as at remote location in OCC Metro Bhawan. The mimic panel on each UPS system shall have of capacitive touchscreen type with good responsiveness.

1.2.14 All alarms and messages generated by the UPS shall be recorded at least for a period of one month, or otherwise the message storage capacity should be at least 500

messages and self-clearing of message in FIFO logic.

- 1.2.15 DMRC will provide LAN port between UPS unit at Shastri Park and the OCC Metro Bhawan and BCC Shastri Park for communication purpose, the point of interface being TER (Telecom Equipment Room) at OCC Metro Bhawan and CER (Central Equipment Room) at BCC Shastri Park. The Contractor shall make all other necessary arrangements such as communication card/ port, cabling from UPS to CER, networking, workstation etc. The workstation at OCC shall be a standard PC with latest configuration (not below i7 processor) and 32" LED monitor.
- 1.2.16 Alarms shall be categorized on these remote terminals based on different severity levels and shall be both acoustic and visual to draw the attention of maintenance personnel in case of need.
- 1.2.17 Remote monitoring system at OCC/CSS shall have state of the art features such as:
- a) Graphical tool illustrating health status of various equipment on a single screen, such as line diagram: normal status of all equipment at a station shown in Green colour and fault status shown in Red colour. The status can be zoomed at various levels to identify specific fault to card level. The Contractor may propose alternate better graphical scheme for review and acceptance of the Engineer.
 - b) Automatically generating and sending messages to concerned maintenance personnel at OCC/CSS;
 - c) Recording and storage of profiles such as voltage/ current/ temperature etc. at some identified important points at stations;
 - d) Pre-warning based on comparison of these defined profiles in order to pre-empt and ~~empt~~ **empt and** prevent breakdowns.
 - e) Contractor will provide the complete software including its licensed version and also hand over the configuration tools for downloading the data and real time remote monitoring of events.
- 1.2.18 Alarms generated by the UPS system locally shall be indicated in two categories namely critical alarms and non-critical alarms. A list of such alarms shall be submitted by the contractor to the Employer's Engineer during design stage for approval.
- 1.3 Diagnostics**
- 1.3.1 The UPS shall be fitted with a Microprocessor based Supervision and Diagnostic System, which monitors all aspects of the UPS operation. The system shall aid in the rapid identification of internal faults. The clock of UPS system should be synchronized with Master Clock System provided by DMRC for accurate event tracing and fault diagnosis through UPS system logs.
- 1.3.2 The UPS shall automatically analyze the condition of the battery string on a programmable period. It shall detect and enunciate the battery failure condition locally and remotely. The periodic test shall not impair the battery readiness in case of normal

1.3.3 Metering and Switchgears

Output Switch gears for UPS-1, UPS-2, SCVS, Spare Cell Charger, SPARE	MCCBs of suitable rating
Metering	AC Voltmeter - To monitor Input voltage RY,BR, YB voltage through selector switch. AC Ammeter - To monitor Input current through selector through selector switch. Indicators for the feeders and output

1.3.4 Surge and Transient Protection (can also be an external device): Class 'B' as per IEEE 62.41 & 62.45.

1.4 Automatic Transfer Switch Specifications

1.4.1 Automatic transfer switches (ATS) shall be modular, compact design, 3-phase, double throw, break before make type.

1.4.2 The automatic transfer switch shall be rated in utilization category AC-33A in accordance with IEC 60947-6-1 or EN 60947-6-1 and capable of making, breaking and carrying continuously the rated current and making on fault without overheating, damage and deterioration.

1.4.3 The automatic transfer switch shall be to international standards and certification, such as CE or UL 1008 Standards for Safety, and shall be of reputed make & proven design.

1.4.4 Each automatic transfer switch shall be equipped with, but not be limited to, the following:

- a) Illuminated indicator for "Normal Supply On" and "Standby Supply On" to be provided at the front cover of the compartment housing the transfer switches.
- b) Transfer mechanism to facilitate automatic/ manual transfer from the normal source to the standby source.
- c) A test switch to simulate mains power failure and indicate the changeover sequence to allow on-load testing.
- d) Auxiliary relays and contacts to facilitate main power source failure for routine testing of the automatic transfer operation.
- e) 2 nos. each NO and NC volt free dry contacts shall be provided for each changeover unit.
- f) The Changeover function shall work without Auxiliary Power Supply with Fail Safe operation.
- g) All indications for all the operations viz., ON, OFF.
- h) Adjustable transfer delay time control from 0 to 1 minutes or more.

1.4.5 The transfer system between the normal and standby sources shall be as follows:

- a) 3 phase sensing circuits with adjustable time delay facility in the ~~range of~~ **range of** ~~0 to 15~~ **0 to 15** seconds shall be provided to monitor the voltage condition of the normal.