BHARAT HEAVY ELECTRICALS LIMITED PHONES:23774494 (EXCHANGE)
CORPORATE RESEARCH & DEVELOPMENT DIVISION
VIKASNAGAR, HYDERABAD - 500 093, INDIA
FAX : 91 40 23770698

ENQUIRY

RD:DP:MPX:F-04

To

-

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Pin

Email :

Attn. .

Enquiry No:	Enq Date:	Due Date:	Delivery By:
271103571	06-AUG-11	03-SEP-11	

PLEASE SUBMIT YOUR QUOTATION IN SEALED COVER SUPERSCRIBED WITH ENQUIRY NO, ENQUIRY DATE AND DUE DATE SUBJECT TO OUR TERMS AND CONDITIONS ENCLOSED, FOR THE FOLLOWING MATERIALS SO AS TO REACH US ON OR BEFORE THE DUE DATE BY 12 NOON. THE TENDERS WILL BE OPENED AT 2 PM ON THE SAME DAY

PLEASE GIVE REFERENCE OF ENQ NUMBER , ENQ .DATE AND DUE DATE IN ALL YOUR CORRESPONDENCE FOR PROMPT ACTION. IN CASE IF YOU ARE NOT MAKING THE OFFER PLEASE POST A REGRET LETTER AND RETURN THE DOCUMENTS.

SL NO	DESCRIPTION / SPECIFICATION	UNIT	QTY
1	MANUFACTURE, TESTING AND SUPPLY OF 30KW DC VOLTAGE REGULATOR AS PER ENCLOSED SPECIFICATIONS (ANNEX-1). IMPORTANT NOTE : a) YOUR OFFER WILL BE SUBJECT TO FOLLOWING TERMS AND CONDITIONS. b) OFFER VALIDITY : FOR 90 DAYS FROM ENQUIRY DUE DATE. c) PRICE BASIS : FOR BHEL R&D, HYDERABAD FOR INDIGENOUS OFFERS. FCA NEAREST INTERNATIONAL AIRPORT FOR FOREIGN OFFERS. d) PAYMENT TERMS : 100% SUPPLY VALUE ALONG WITH TAXES BY EFT/RTGS WITHIN 30 DAYS OF RECEIPT AND ACCEPTANCE OF CONSIGNMENT AT BHEL R&D STORES, HYDERABAD FOR INDIGENOUS OFFERS. 100% FCA VALUE BY IRREVOCABLE LC FOR FOREIGN OFFERS. e) PENALTY FOR DELAYED DELIVERY SHALL BE APPLICABLE @ 0.5% PER WEEK OR A PART THERE OF SUBJECT TO A MAXIMUM OF 10% OF ORDER VALUE f) EXCISE DUTY SHALL BE EXEMPTED COMPLETELY BASED ON ED EXEMPTION CERTIFICATE ISSUED BY BHEL R&D FOR INDIGENOUS OFFERS. g) PLEASE INDICATE SEPARATELY APPLICABLE CST/VAT/SERVICE TAX RATES, ITEM WISE FOR INDIGENOUS OFFERS. PLEASE NOTE C FORM SHALL NOT BE ISSUED. h) PROVIDE NAME OF CONTACT PERSON, MOBILE NO, EMAIL ID, PHONE/FAX NO IN YOUR OFFER. i) REVERSE AUCTION: BHEL RESERVES THE RIGHT TO PROCURE ABOVE ITEMS THROUGH REVERSE AUCTION AMONG QUALIFIED BIDDERS. j) SUPPLIERS SHOULD SUBMIT THE COMPLIANCE STATEMENT DULY FILLED.	NO	4

OPEN TENDER NOTE

PLEASE SUBMIT YOUR OFFER IN TWO PARTS AS PER ENCLOSED "GENERAL TERMS AND CONDITIONS OF ENQUIRY, LOADING FACTORS & CONTRACT FOR THE PURCHASE OF GOODS/ SERVICES" IN SEPARATE SEALED COVERS AS DETAILED BELOW:

1) FIRST COVER SHALL CONTAIN A) TECHNICAL & COMMERCIAL BID, B) COMPLIANCE STATEMENT, C) UN-PRICED PRICE BID, I.E. A COPY OF THE PRICE BID WITH THE PRICE(S) COLUMNS LEFT BLANK D) BIDS WITHOUT THESE ENCLOSURES SHALL NOT BE CONSIDERED.

2) WHEREVER VENDOR REGISTRATION FORM AND EFT DETAILS HAVE BEEN SUBMITTED EARLIER, THE SAME NEED NOT BE SUBMITTED AGAIN UNLESS THERE IS A CHANGE.

3) WHEREVER INDIAN AGENTS ARE REPRESENTING ON BEHALF OF THEIR PRINCIPLES, THE RELEVANT AUTHORISATION LETTER & AGREEMENT COPY TO BE ENCLOSED ALONG WITH TECHNICAL BID TO CONSIDER THE OFFER.

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4) SECOND COVER CONTAINING PRICE BID. IF THE PRICE BID IS FOUND TO BE DIFFERENT FROM THE UN-PRICED PRICE BID IN ANY WAY, THE OFFER WILL BE REJECTED.
5) UNSIGNED OFFERS ARE LIABLE FOR REJECTION.
6) PLEASE VISIT BHEL WEBSITE REGULARLY FOR ANY UPDATES AND ANY ADDITIONAL INFORMATION PRIOR TO SUBMISSION OF OFFER.
7) REVERSE AUCTION: BHEL RESERVES THE RIGHT TO PROCURE ABOVE ITEMS THROUGH REVERSE AUCTION AMONG QUALIFIED BIDDERS.
8) ALL OFFERS MUST INCLUDE NAME OF CONTACT PERSON, PHONE NO, FAX NO, EMAIL ID. UNSIGNED/INCOMPLETE OFFER(S) ARE LIABLE FOR REJECTION.
9) TAXES & DUTIES QUOTED WILL BE TAKEN FOR COST EVALUATION & ORDER PLACEMENT AND NO CHANGE WILL BE ENTERTAINED LATER EXCEPT IN THE CASE OF CHANGES MADE BY THE GOVERNMENT.
10) CHANGES IN TAXES AND DUTIES BECAUSE OF THE CHANGES IN TURNOVER ETC. WILL BE TO THE SUPPLIER'S ACCOUNT.
11) IN CASE ANY TAXES/DUTIES EXEMPTED, A SELF DECLARATION FOR THE SAME MAY BE ATTACHED TO THE OFFER.
12)"BEING A RESEARCH INSTITUTION BHEL R&D CAN AVAIL CUSTOM DUTY EXEMPTION IN TERMS OF GOVT NOTIFICATION NO 24/2007 - CUSTOMS DATED 1.3.2007 AND CENTRAL EXCISE DUTY EXEMPTION IN TERMS OF GOVT NOTIFICATION 16/2007 - CENTRAL EXCISE DATED 1.3.2007. HENCE SUPPLIERS ARE REQUESTED TO SUBMIT THEIR BIDS WITH OUT EXCISE DUTY".
13) GUARANTEE CERTIFICATE: REQUIRED
14) MANUFACTURER'S TEST CERTIFICATE : REQUIRED
15) PRE-DISPATCH INSPECTION : REQUIRED
16) PLEASE QUOTE ON FOB BASIS ONLY
17) ERECTION & COMMISSIONING : REQUIRED
18) SPARES : REQUIRED

AS WE ARE ENGAGED IN R&D ACTIVITY "C" FORM WILL NOT BE ISSUED

PLEASE FILL UP THE ENCLOSED VENDOR REGISTRATION FORM AND SEND IT ALONG WITH YOUR QUOTATION. OTHERWISE YOUR QUOTATION WILL NOT BE CONSIDERED.

Yours faithfully
for
BHARAT HEAVY ELECTRICALS LTD

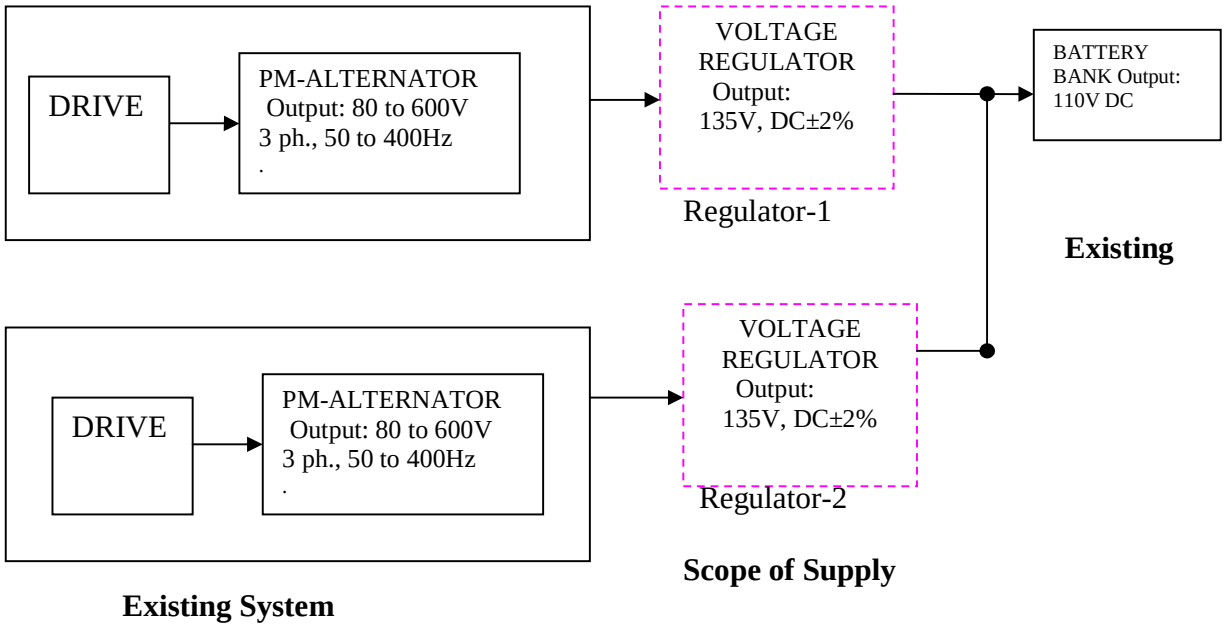
RAVINDER KUMAR C
Engineer

Email: crkumar@bhelrnd.co.in
Direct Phone : 91-40-23882504
Mobile : 91-7569616111

Annexure-1

Specification for 30kW DC Voltage Regulator

1. Function: The function of the voltage regulator is to convert the variable three phase AC voltage & frequency derived from alternator to constant DC voltage for charging batteries in Railway applications. The input and output details of the voltage regulator with other parameters is given below.



2. OUTPUT

2.1 Rated Capacity	: 30kW
2.2 No load DC output Voltage	: 135V DC
2.3 DC output voltage setting	: 129+-0.5v, 97A at 200Hz.
2.4 Voltage Regulation	: ±2%
2.5 Efficiency at full load	: 95% min at 1800rpm, 240Hz.
2.6 Voltage ripple	: within 2%
2.7 Current ripple	: within 10%
2.8 Load variation	: 10 A to 193A.
2.9 Speed variation	: 93Hz to 334Hz.
2.10 Voltage at 15% overload	: 120V min. at 222A.
2.11 Current limiting	: 230A max.
2.12 Battery charging current limits (max)	:110A

3. INPUT

3.1 Voltage Range	: 80V to 600V AC, 3 phase.
3.2 Frequency Range	: 50 to 400Hz.

4. Operating service conditions

4.1 The ERRU shall function satisfactorily in the ambient temperature range from –5 degree C to 55 degree C and 100% relative humidity. The equipment shall be designed for mounting on the under-frame and shall be suitable for working in a heavily dust laden atmosphere which may also contain brake block dust.

4.2 The coaches are expected to run up to a maximum speed of 130 km/h in varying climatic conditions existing throughout India. All accessories to be mounted on the coach under frame shall be designed to withstand service vibrations and shunting shocks.

5. Construction features

The housing of regulator equipment shall be as per Drg. No SKEL-2260-A and RDSO/PE/SK/AC/0060-2003(Rev-0) latest. The regulator, power circuit and its electronic components will be as per **clause 7.1, 7.2** and **7.3** of RDSO specification no. **RDSO/PE/SPEC/AC/0013-2007(REV-01)** for electronic rectifier cum regulator unit for 25kW.

6. Protection/special features:

The protection features of the regulator shall meet all the requirements mentioned in clause 7.4 to 7.20 of RDSO specification no. **RDSO/PE/SPEC/AC/0013-2007(REV-01)** for electronic rectifier cum regulator unit for 25kW.

7. Tests and performance

The voltage regulator will first be tested in BHEL Laboratory and again will be tested and used at Railway site. The regulator will be tested as per **clause 11, 12 and 13** of RDSO specification **RDSO/PE/SPEC/AC/0013-2007(REV-01)** for electronic rectifier cum regulator unit for 25kW. The environmental testing will be carried out at RCI, Hyderabad by BHEL.

8. Dimension & Weight

Size : **< 730(L) x 250(W) x400(H) mm**
As per drawing in **Annex-2**.

9. Warrantee-Voltage Regulator should carry a warrantee for a period of 1 year, against any manufacturing defect from the date of installation at railway site.

10. Technical Literature Data

Complete technical literature such as printed catalogs / data sheets of all components like semiconductor devices, capacitors, other important components used in the quoted supply items, PCB details of control card etc., shall be provided along with the offer. All drawing and design details should be provided as per clause no.15 of RDSO specification no. **RDSO/PE/SPEC/AC /0013-2007(REV-01)** for electronic rectifier cum regulator unit for 25kW.

11. Information required to be submitted along with the offer:

11.1 Weight, Size and a Drawing indicating the overall dimensions and mounting details.

11.2 Full technical details along with PRINTED Catalogs (2 sets) / Data sheets of all major components used.

12. Erection & commissioning

Erection & commissioning of the equipment to be carried out at Railway site.

13. Spare Item

The supplier should be able to supply spares for at least for a minimum period of 5 years after expiry of one year warrantee for reliable operation of the regulator.

*The technical specification no.**RDSO/PE/SPEC/AC/0013-2007 (REV-01)** for electronic rectifier cum regulator unit for 25kW & 4.5kW alternators fitted on AC & TL coaches is available online at RDSO website http://www.rdso.indianrailways.gov.in.

* If any additional technical information is required from BHEL (R&D), the supplier may get clarifications before submitting the offer.

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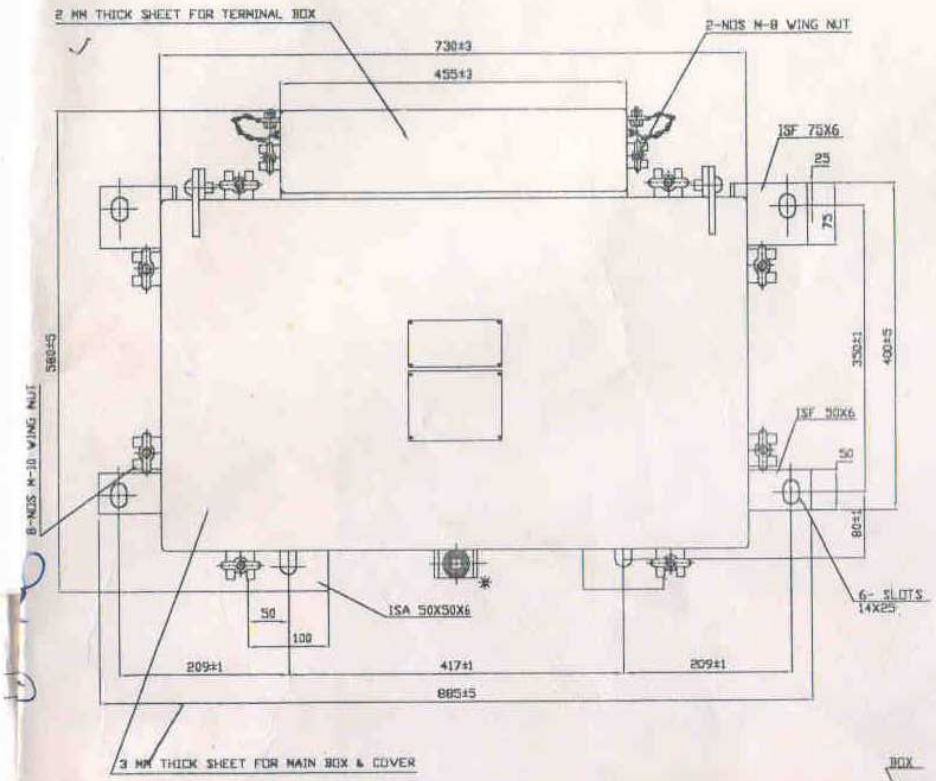

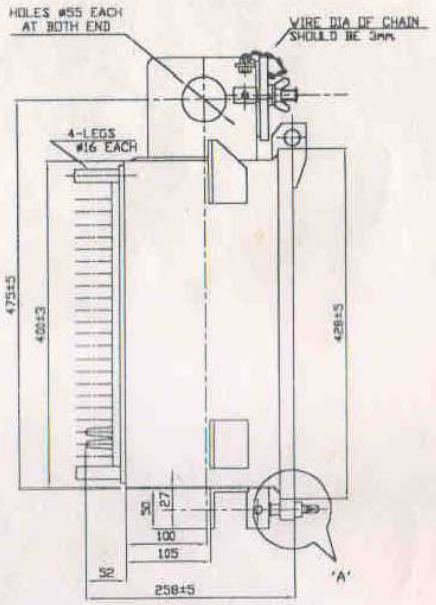

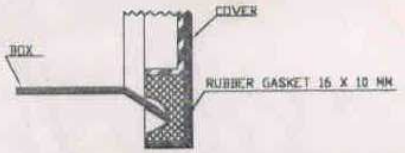

DETAILS= 'A'

ES :

ABLE LOCK FOR KEY TO RDSO DRG NO. SKEL - 1502

HOUSING SHALL BE DUST AND WATER PROOF CONFORMING TO IP - 55 OF IS : 4691

RECTIFIER REGULATOR HOUSING SHALL BE ZINC SPRAYED CONFORMING TO IS : 5905

GASKET SHALL BE FIXED WITH THE HELP OF ADHESIVE FOR FULL LENGTH OF THE SLOT

RESEARCH DESIGNS & STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW-226 011

POWER SUPPLY & EMU DIRECTORATE

TECHNICAL SPECIFICATION NO. RDSO/PE/SPEC/AC/0013-2007 (REV-1)

FOR

ELECTRONIC RECTIFIER-CUM-REGULATING UNIT (ERRU) FOR 25 KW & 4.5 KW ALTERNATORS FITTED ON AC & TL COACHES

SN	DATE OF REVISION	NO. OF PAGES	VERSION	REASON FOR REVISION
1.	April 2000	42	Rev. 0	First issue
2.	Sept. 2002	36	Rev. 0 with Amdt. 1&2	Second issue
3.	July 2007	41	Rev. 1	In view of standardization of ERRUs and to increase the reliability of the components

APPROVED BY

Executive Director / PS & EMU

Specification for Electronic Rectifier-cum-Regulating Unit (ERRU) with Voltage controller for 25 KW and 4.5 KW Brushless Alternators for Air conditioned and Non AC Conventional Self-generating Coaches

0.0 FOREWORD

0.1 Presently Alternators and Rectifier-cum-Regulating Equipment for Air Conditioned and conventional Self-generating coaches are being procured as per RDSO Specification NO. RDSO/PE/SPEC/AC/0056-2004 (Rev.0) and RDSO/PE/SPEC/TL/0054-2003 (Rev.0) with amendment No.1 for 25 KW and 4.5 KW Alternators respectively. The existing designs of RRU (Rectifier-cum-Regulating Unit) is based on magnetic amplifier, with associated electronic control circuitry consisting of auxiliary diodes, zener diodes, resistors, capacitors etc. This design of RRU is having its inherent limitations of voltage regulation, which is ±4% and ±5% for 25 kW & 4.5 kW respectively. This also does not have battery charging feature of charging the VRLA (Valve Regulated Lead Acid) batteries with current limit at constant voltage. Since working of these RRUs is based on magnetic core saturation, the voltage and current ripple in the 110V DC output are varying substantially depending upon the type of load and speed which may affect performance / life of VRLA batteries.

0.2 Most of the AC coaches are fitted with 25 kw alternators with 1100 Ah 56 nos. and old AC coaches having alternators are fitted with 2V/800 Ah 56 Nos. Conventional lead acid batteries and underslung AC equipment. AC coaches with Roof Mounted Package Unit will normally be equipped with two sets of 25 kw Alternators suitable for parallel operation. Other types of Air Conditioned coaches i.e. First Class AC Coaches may be equipped with only one set of 25 kw brushless alternator, whereas BG 110V non AC coaches are fitted with 4.5 kw brushless alternators.

DC output of the 25 kw alternator with normally supply load consisting of Air Conditioning equipment through 25 KVA Inverters, incandescent and fluorescent light, air circulating fans and in addition charging a bank of 56 nos. VRLA batteries of 1100 Ah capacity at a nominal voltage of 110V DC. DC output of 4.5 kw Alternators will normally supply load consisting of incandescent and fluorescent light, air circulating fans and in addition charging a bank of 18 nos. monoblock of 6V/120 Ah LA batteries.

0.3 The battery is connected to the alternators through RRU/ERRU, which converts AC output of alternator into regulated DC and prevents reverse flow of current from battery to the alternator during periods of non-generation. The air conditioning plant and coach light and fan circuit are connected across DC output. Some of the coaches are fitted with AC fans and light circuits connected across inverter AC output.

0.4 During failure analysis of the Rectifier-cum-Regulating Unit (RRU) with Magnetic amplifier design, the problem of magnetic amplifier failure and its associated components has been experienced. It is felt necessary to go far an alternative better design using IGBT devices with its control circuitry to achieve higher reliability of the equipment.

0.5 IGBT based Rectifier-cum-Regulating Unit i.e. Electronic Rectifier-cum-Regulating Unit ERRU shall have additional safety features viz. overload protection with fast corrective response, battery charging with current limit, battery charging voltage limit etc. Most of these features are not available in the MA type design. It shall be maintenance free item.

1.0 SCOPE

1.1 This specification covers the design, manufacture, testing supply of Electronic Rectifier-cum-Regulating Unit (ERRU) of 25 kw or 4.5 kw ratings with common UVC for 25 kw / 4.5 kw alternators for providing on self-generating air conditioning and conventional coaches for supplying essential passenger amenities.

1.2 The Electronic Rectifier-cum-Regulating Unit (ERRU) shall work in conjunction with transom mounted alternators of the same rating which conforms to RDSO Specification as mentioned in clause 0.1 of this Specification. It shall also be possible to retrofit the ERRU in the under frame of the BG AC & TL coaches to work satisfactorily in conjunction with the alternators of same ratings. Important sub-assemblies e.g. UVC and display unit shall be common for 4.5 kW and 25 kW ERRU to reduce inventory.

1.3 The scope of supply shall include the following unless otherwise specified:

i) **For AC coach**

a)	Electronic Rectifier cum Regulating Unit (ERRU) of 25kw	--	2 Nos.
b)	External Coach indication panel	--	1 No.
c)	Cables along with connectors for additional wiring for ERRUs	--	1 set
d)	External Hall Sensor Unit, for sensing battery current	--	1 No.
e)	Data downloading unit for every 10 ERRUs	--	1 No.
i)	Instruction/maintenance manual including trouble shooting details	--	1 no

ii) **For TL Coach**

a)	Electronic Rectifier-cum-Regulating Unit (ERRU) of 4.5kW with internal display	--	1No.
b)	Data downloading unit for every 10 ERRUs	--	1No.
c)	Instruction/maintenance manual including trouble shooting details	--	1No.

Purchaser can specify the items required as per his requirement.

1.4 The design and manufacture shall fulfil the following broad requirements:

i) Long life minimum maintenance

ii) Maximum reliability

iii) Universal application with in the speed range

iv) Self exciting the installation, shall also be able to operate without a battery

v) Well protected against extraneous interference and pilferage

vi) It shall meet requirements of load consisting of fluorescent and incandescent lamps, fans , motors, Inverters, battery etc.

vii) Protection for battery over charging at constant voltage

viii) Protection for over load

ix) Over voltage protection

x) Voltage and current ripple contents as specified

xi) Suitable for parallel operation with a load sharing difference of less than 10 amperes.

xii) Modular type for controller

xiii) Adequate rating margin

xiv) The semi conductors and other parts used shall conform to reliability assurance specification for electronic components used in rolling stock. RDSO Specification No. ELRS/SPEC/SI/0015 Oct. 2001

xv) Adequate surge protection

xvi) Fail safe

2.0 TERMINOLOGY

For the purpose of this Specification, the following definitions shall apply:

ALTERNATOR: An axle driven power generating machine mounted on the bogie of the coach driven through V-belt drive consisting of axle and alternator pulleys with V-belts. These are approved by RDSO conforming to the specifications as mentioned in clause 0.1 above.

ERRU: Electronic Rectifier-cum Regulating Unit ERRU.

POWER CIRCUIT: ISO PACKS/Power diode modules, heat sinks, other voltage and current sensing units, magnetic components, phase fuses, bus bars capacitors etc. except Universal Voltage Control unit.

UNIVERSAL VOLTAGE CONTROLLER (UVC): This is an electronic controller unit having micro-processor/micro-controller/PWM controller which is common for all ratings i.e 25 kw & 4.5 kw of alternators and respective ERRU having different power circuits. UVC should be able to identify the rating of the alternator and automatically adjust the setting parameters as per this specifications according to the rating of the alternator and battery. It shall have the rating corresponding to 25 kw alternator. All the components other than mentioned above, shall form part of UVC.

CUT-IN-SPEED: The alternator speed in rev/min. at which the rectified output is 110 volts at no load for 25 kw and 108 volts at no load for 4.5 kw alternators.

MINIMUM SPEED FOR FULL OUTPUT (MFO): The minimum alternator speed in rev/min at which it gives full rated output at 129 volts, 194 amps for 25 kw and 120 volts 37.5 amps. for 4.5 kw Alternators.

NO LOAD CURRENT: No load current means zero load current.

BASE LOAD: 10 amps. load current for 25 kw and 1 amp. load current for 4.5 kw.

IGBT: Insulated Gate Bi-polar Transistor – a semi conductor device used as switching on and off to control DC input signal to the field for regulating DC output.

HALL SENSOR: It is an Electronic devices to be used for sensing DC/AC current for giving input to control circuit.

COACH INDICATION PANEL (CIP): It will be fitted in AC coach power panel. Its LCD display will show the set parameters and the recorded data

3.0 OPERATING SERVICE CONDITIONS

3.1 The ERRU shall function satisfactorily in the ambient temperature range from –5 degree C to 55 degree C and 100% relative humidity. The equipment shall be designed for mounting on the under-frame and shall be suitable for working in a heavily dust laden atmosphere which may also contain brake block dust.

3.2 The coaches are expected to run up to a maximum speed of 130 km/h in varying climatic conditions exiting throughout India. All accessories to be mounted on the coach under frame shall be designed to withstand service vibrations and shunting shocks.

4.0 RATING

The standard rating at the DC output terminals of the Electronic Rectifier-cum- Regulating Unit for different ratings of alternator shall be as under:

i) 25 KW : 130V, 193A

ii) 4.5 KW : 120V, 37.5 A

5.0 PARTICULARS OF DRIVE

The alternators are driven through V-belt drive system consisting of alternator and axle deep groove pulleys fitted either on both ends of alternator shaft or at one end for AC and Conventional coaches respectively. The power transmission is through V-belts of size 3155 LP (C-122). Total 12 nos. (6 on each side) and 4 nos. (only one side) of C-122 size are provided on AC and TL alternators. The speed of alternator shall vary from 0 to 2500 rpm. The coach wheel diameter is 915 mm when new and 813 mm when fully worn, New wheel dia shall be considered for making calculations of speed of the train in KMPH corresponding to cut-in speed and MFO speeds of alternator.

6.0 FOR AC COACH APPLICATION:

i) 25 KW: Alternator with ERRUs

The cut-in speed and MFO speed of the alternator working in conjunction with ERRU shall be as low as possible consistent with economical design. The cut-in and MFO speeds shall be less than 350 and 700 rpm respectively for AC Alternators. The cut-in and MFO speeds can be

accepted upto 400 and 800 rpm in special circumstances to be explained by the vendor. The regulator shall be capable of working at maximum speed of 2500 rpm. No negative tolerance is permitted on the voltage and current for measuring cut-in speed and minimum speed for full output.
The ERRU shall meet the following requirements:

OUTPUT CHARACTERISTICS

25 KW ERRU:

No load DC Output voltage:	135 V (Maximum)
DC Output Voltage setting* :	129 ±0.5 V, 97 A at 1500 rpm
Voltage regulation:	±2% of set voltage
Efficiency at full load at 1800 rpm:	95% (minimum)
Voltage ripple:	within 2%
Current ripple:	within 10%
Load variation:	10 A to 193 A
Speed variation:	700 rpm to 2500 rpm
Voltage at 15% over load:	120 V (minimum) at 222 A
Current limiting* :	230 A (maximum)
Battery charging current limits* (max):	110 A

*** It shall be possible to set these limits from UVC as well as CIP**

The DC output voltage at full load shall be suitable for setting from 120 V to 130 V. Similarly, the current limiting setting of DC output current, battery charging limit shall also be possible to adjust within 20% of above values. Normally the above settings shall be adopted for the ERRU of 25 kw ratings.

ii) **FOR TL COACH APPLICATION**

4.5 kW: Alternator with ERRU

The cut-in speed and MFO speed of the alternator in conjunction with ERRU shall be as low as possible consistent with economical design. The cut-in and MFO speeds shall not be higher than 350 and 600 rpm respectively for conventional Alternators. The regulator shall be capable of working at maximum speed of 2500 rpm. No negative tolerance is permitted on the voltage and current for measuring cut-in speed and

minimum speed for full output. The ERRU shall meet the following requirements:

OUTPUT CHARACTERISTICS

4.5 kW ERRU:

No load DC Output voltage :	130 V (Maximum)
DC output voltage setting*	126±0.5 V at 19 A at 1500 rpm
Voltage regulation:	±2% of set voltage
Efficiency at full load at 1800 rpm:	95% (minimum)
Voltage ripple:	within 2%
Current ripple:	within 10%
Load variation:	1 A to 37.5 A
Speed variation:	600 rpm to 2500 rpm
Voltage at over load of 40 A:	115 V (minimum)
Current limiting* :	43 A (maximum)
Battery charging current limits* (max.):	24 A

*** It shall be possible to set these limits from UVC / Display Unit**

The DC output voltage at full load shall be suitable for setting from 120 V to 130 V. Similarly DC output current limit and battery charging current limit shall also be adjustable within 20% of above values. Normally the above settings shall be adopted for the ERRU of 4.5 kw ratings.

7.0 CONSTRUCTION DETAILS

7.1 A) Housing.

The housing of electronic rectifier-cum-regulating equipment shall generally be as per Drg. No. SKEL-2260/A and RDSO/PE/SK/AC/0060-2003(Rev-0) latest alteration for 4.5 kw and 25 kw respectively and shall be approved by RDSO. Suitable gaskets of neoprene rubber shall be provided for cover of electronic rectifier regulator and terminal box to prevent ingress of dust, water and moisture. The enclosure shall meet the requirement of hose proof test as per IP55 protection level of IS:4691-1985.

B) UVC

Universal Voltage Controller shall be equipped with micro-processor/micro-controller/PWM controller to meet the various requirements laid down in clause 6.0 of this specification. Wherever possible adequate design redundancy to take care of controller failure from total system failure/hanging. The design of every UVC shall have provision to ensure proper load sharing between two alternators provided on the same AC coach and the difference of load sharing shall not be more than 10 A enabling to achieve high reliability of alternators avoiding continuous overloading of one alternator. There shall also be a provision of communication between two ERRU running in parallel. The UVC of ERRU of different rating i.e. 4.5 kw, and 25 kw shall have universal application with a common design to achieve inter-changeability among the same make.

The manufacturer shall have to declare their design and its capacity. The UVC shall be suitable to work with 25 kw & 4.5 kw capacity alternators in the existing field conditions.

UVC shall preferably have following features for improving reliability:-

i) UVC shall preferably equipped with minimum of 16 bit industrial microprocessor/microcontroller with built in USB and PWM control ports.
ii) No through hold type of microprocessor/microcontroller should be used for high reliability
iii) External programme memory should not be used with microprocessor / microcontroller for highest reliability of memory fetching.
iv) The PCB design of UVC shall be done only on single card to eliminate the interconnection between PCB and easy service on card replacement basis.
v) Only sealed membrane key pads should be used alongwith UVC for highest reliability.
vi) The discrete power supply for powering the UVC microprocessor / micro controller must be electrically isolated from coach battery DC power.

Following indication shall be available on UVC / Display unit in case of 4.5 kW, whereas for 25 kW ERRU on UVC and CIP
i) Capacity of Alternator
ii) Healthiness of UVC

7.2 **Power Circuit:**

For 25kw, ISO-PACKs bridges/Power Block modules with adequate temperature margins shall be provided for converting AC output of alternator to DC voltage. “The power blocks diode modules shall not have

PIV of less than 1200 V and 350 Amp. Mean forward current at 100 deg C case temperature with 180 deg.C sine wave conduction for AC coach application.

For 4.5 kw ERRU the ISO-PACK/Power Block diode modules shall not have PIV of less than 1200V and 50A averaged forward current at 180 deg. C conduction. Preferably Power Block Diode Modules may be used for converting AC to DC. Torque wrench shall be used to fix the power block diodes modules base and for making diodes main connections with recommended torques. Torque values should be displayed on the ERRU box inside.

For all devices in the power circuit and field circuit, PIV shall be not less than 1200V. In case, manufacturer provides snubber capacitors/circuits, its rating shall have peak rating matching to PIV rating of diodes with safe temp. margins. Similarly, diodes used in excitation circuit and free wheeling diodes shall have adequate thermal margin.

The surface of the heat sink for diode/devices mounting shall have a proper finish to match with its base for better heat conduction. Recommended machining tolerances over the device/diode mounting area of the heat sink shall be as follows:-

- Flatness 0.03 mm
- Roughness 1.6 µ metres.

The alternator manufacturers shall have the requisite equipment/ measuring instruments to ensure the heat sink surface finish as mentioned above.

Power circuit and UVC shall have separate heat sinks as per enclosed drawings to meet the requirements of heat dissipation such that the temperature of the electronic devices remain within the laid down limits.

7.3 Electronic Components:

The semi-conductors and other electronic components used shall be of proven designs with high reliability conforming to relevant International Standards (IEC) and shall be suitable to work satisfactory under the stringent service conditions for this Rolling Stock application. Commercial grade components shall not be used. All these components shall be screened as per “Reliability Assurance Specification for Electronic Components used in Rolling Stock” – RDSO specification No. ELPS/SPEC/SI/0015 - Oct. 2001, unless otherwise approved by RDSO.

7.4 **Protection/Special Features**

The ERRU shall be provided with the following protection/special features:

i) Over-voltage/surge protection

ii) DC Output Short circuit protection

iii) Protection from over-charging the battery with current limit

iv) Sensing of AC/DC current and battery charging current shall be done using Hall Sensors of proven design having high reliability as per table given below:-

Item	Description	No. of Hall Sensor	Ratings
4.5 kW ERRU	Load current	1	50 Amps
	Battery charging current	1	50 Amps
24 kW ERRU	Load current	2	200 Amps
	Battery Charging Current	2	300 Amps

7.5 The voltage and current ripple in DC output voltage under different load and speed conditions shall not exceed 2% and 10% respectively.

7.6 For the purpose of universal application when used with other makes of alternators, the MFO speed can be permitted a tolerance of +50 rev/min. on speeds specified in Clause 6.0.

ERRU of one make/type shall work satisfactorily with alternators of other makes. UVC of one make/type shall work satisfactorily with any other rating of ERRU of the same make.

7.7 **Over-voltage Protection & Surge Protection:**

Due to component failure/open circuit in ERRU, static over voltage protection circuit should be provided with no nuisance tripping under no-load or when the system running with VRLA/conventional lead acid battery connected at the output. During sudden throwing of load (without battery connected), the over voltage static relay may trip but must reset by itself automatically. Latching of the static relay may be achieved under fault condition with battery supply available at the DC output. Certain time delay may be provided for static relay operation so that the static relay does not trip when load is thrown off suddenly with battery connected. However, the time delay provided should be less than 2 secs. in order to

protect the system under genuine fault conditions. The tripping voltage of the static relay may be set between 138 ± 1 V.

A: 25 kW ERRU

SN	Load	Speed of testing	Condition of ERRU	Status of static relay	Remarks
1.	O Amp DC	800, 1500 2500 rpm	ERRU working normal	Tripping/Not tripping	Transient/ Stabilized voltage to be recorded
2	10 Amp DC	800,1500, 2500 rpm	(a)Opening / shorting of control	-do-	-do-
3.	96.5 Amp DC	-do-	-do-	-do-	-do-
4.	193 Amp DC	-do-	-do-	-do-	-do-
5.	Throwing off 193 Amp load to no load	-do-	ERRU working normal	-do-	-do-
6.	Sudden loading from No load to full load	-do-	-do-	-do-	-do

B: 4.5 kW ERRU

S. N	Load	Speed of testing	Condition of ERRU	Status of static relay	Remarks
1.	O Amp DC	350, 600, 1500 2500 rpm	ERRU working normal	Tripping/Not tripping	Transient/ Stabilized voltage to be recorded
2	1 Amp DC	600,1500, 2500 rpm	(a)Opening / shorting of control	-do-	-do-
3.	19 Amp DC	-do-	-do-	-do-	-do-
4.	37.5 Amp DC	-do-	-do-	-do-	-do-
5.	Throwing off 37.5 Amp load to no load	-do-	ERRU working normal	-do-	-do-
6.	Sudden loading from No load to full load	-do-	-do-	-do-	-do

Note (Applicable for both 4.5 kW & 25 kW ERRU) :-

i) During the testing of OVP, the status of static relay (tripping/not tripping) and DC output voltage shall be recorded under the above conditions.

However, for prototype test machines the transient / steady state DC Output voltage along with rise/fall time shall be recorded using digital storage oscilloscope having suitable interface with PC/Printer for down loading the wave form.

ii) OVP shall not trip under condition at item 1, 5 & 6.

iii) Battery Circuit shall be kept out of circuit while testing OVP as per condition mentioned at item no. 1, 5 & 6.

iv) OVP testing as mentioned at S.No.2, 3 & 4 shall be done using battery bank of adequate capacity and same shall be kept in perfect healthy condition.

v) If output voltage increases set voltages i.e. 135±2 and remains more than 2 seconds it should latch.

vi) Software OVP shall be set at 138±1 V whereas separate OVP shall be set at 141±1 V.

7.8 Electronic Rectifier Cum Regulating Unit box shall be zinc sprayed conforming to IS-5905.

7.9 The electronic power devices shall be well protected from surges and spikes caused during working condition of the ac coaches. All electronic components including condensers, capacitors and resistance used in the controller shall be de rated sufficiently for safe working during over loads, no loads, at maximum temperatures and highly humid conditions.

7.10 The printed circuit boards (PCBs) shall be protected against dust and highly humid atmospheric conditions. The PCBs shall be properly fixed with proper rubber bushes at the fixing areas so that due to vibration and buffer shocks the PCBs will not damage. A good quality of PCB with minimum 1.6 mm thick shall be used. Each PCB shall be provided with terminal board with wago type preferably or similar reputed make connectors, so that external connections shall be easily provided.

7.11 Anodised name plates shall be provided for the following

i) All fuses with rating

ii) Current sensors with ratings

iii) Terminal Boards

iv) Inside the regulator terminal box U, V, W,, F+, F-, DC+, DC- BC+ and protection indication (BC+ not required in case of 25 KW ERRU)

v) Inside the cover block circuit diagram

vi) Aux. Equipment

Terminal identification marking shall also be provided on an anodised name plate in line with the existing design of Rectifier-cum-Regulator terminal box.

In addition, identification marks for phases, field connections etc. i.e. U, V, W, F+, F-, DC+, DC-, BC+ shall be punched on the respective terminal posts.

7.12 The bus bar holes shall be punched to the proper sizes of holes. The sharp corners and burs shall be removed. The holes shall be provided at the center of the bus bars. The size of the copper bus-bar shall be minimum 90 sq. mm preferably 18 mm x 5 mm cross-section of electrolytic copper or use of elastomeric cable of equivalent size for 25 kw. Whereas the bus bar size of 16 sq. mm or use of elastomeric cable of equivalent size may be used for 4.5 kw ERRU. Suitable bi-metallic washers shall be used wherever required for making connections at aluminium and copper contacts.

As far as possible number of bends on the bus bars shall be minimised. The design of bus bars shall be with “L” bends. The bar flat wise ‘C’ bends shall be avoided. Bus bar bends shall be done on jigs. Only approved bus bar lay out shall be provided.

7.13 The three phase bus-bars U, V, W shall be provided with yellow colour, DC (+ve)–Red, DC(-ve)–Blue and BC(+ve)–Black coloured heat shrinkable sleeves shall be provided as per above scheme.

7.14 Inside the regulator except fuses all the power connections shall be provided with locking washers to avoid loose connections and unnecessary tampering on the power connection.

The internal control wiring shall be done with PTFE cable size 0.96 sq. mm / 1.5 kV for both 25 kW & 4.5 kW regulators. 1.23 sq. mm/1.5 KV PTFE cable shall be used for field circuit. For capacitor circuit 2.5 sq.mm cable shall be used. Proper stiffner arrangement for cable securing shall be done for wiring with ferrule markers with nos. to avoid any loose hanging of cables and ease of terminal identification during maintenance.

For external control wiring for 25 KW ERRU 12 wire control cable shall be used between one ERRU and coach indication panel. Similar cable shall be used for another ERRU. Cable shall be flexible PVC insulated Tinned Copper Strands and Twisted Pair, screened, 12 core with each core of 1sq. mm. Control cables shall be connected to ERRU and coach indication panel end with the help of L type 12 pin connector of following type:

(a) MS 3102E 28-18 for panel side
(b) MS 3108F 28-18 for cable side

Manufacturer shall use control wires as per enclosed table so that all makes of ERRU can work without changing the connections Each wire no. and pin no. shall be easily visible for identification. Inter strand shorting in the control cable should not affect the performance of the ERRU. The cable should be rugged and shielded to protect it from EMI / EMC interferences.

Proper stiffener arrangement for control cable securing shall be done for internal wiring of ERRU with ferrule markers with numbers to avoid any loose hanging of cables and ease of terminal identification during maintenance.

7.15 All the auxiliary equipment like choke, transformers, filter condenser, field fuses, bleeder resistance shall be preferably mounted on the auxiliary equipment fixing base with a terminal board. If the auxiliary equipment fixing board (AEB) has been provided, it shall be possible to be removed with equipment and re-fixed. The equipment mounted on the board shall not foul or infringe with power blocks or power circuit.

7.16 For the better cooling of UVC, a cast aluminium heat sink may be provided on the regulator backside. The bottom side of UVC may be provided with 6 mm thick machined aluminium in flush with heat sink. The IGBT, Transistors etc. may be mounted on the aluminium inside the box. The UVC may be fixed at the bottom right corner of regulator. The heat sink provided at the back of UVC box, shall be provided with suitable fixing arrangement.

7.17 The cast aluminium/alloy heat sink cooling fins shall be black anodised for better cooling. For fixing screw metal inserts with knurling / helicoil shall be provided so that the fixing screws can be provided from inside the regulator box. The depth of tapped portion shall be adequate in side the metal insert. No hole or tapped screw is visible from the cooling fin side to avoid water entry.

7.18 The fuse mounting shall be such that the 'FUSE BLOWN INDICATION' is clearly visible and easily replaceable.

7.19 The DC current and battery current sensors shall be mounted on insulated board and then fixed so that the heat transfer from the heat sink can be avoided.

7.20 Testing kit for ERRU testing shall be designed to test the circuits at workshop before assembly. The testing kit shall be able to test full regulator circuit and also its main components like UVC IGBT, Diodes etc.

8.0 INTER CHANGEABILITY/UNIVERSAL APPLICATION

The UVC of one make for a rating shall be interchangeable with other ratings of ERRU of same make. The mounting dimension of the UVC in all ratings of ERRU of a make shall be same for making it interchangeable. ERRU of a rating shall be capable to work satisfactorily in conjunction with all other make of alternators having same rating. For 25kw, both ERRUs & CIP as a set shall be interchangeable.

9.0 ANTI-PILFERAGE MEASURES

Design of ERRU shall incorporate anti-theft arrangement to avoid the pilferage of components of ERRU during service. The detailed drawings for this shall be approved by RDSO.

10.0 MARKING

The ERRU shall be provided with suitable name plates on which the following shall be marked:

i) Maker's name and trade marks

ii) Rated capacity of the ERRU

iii) Maximum Voltage and current rating

iv) Specification number

v) Serial No. of the ERRU in which first two digits shall indicate year of manufacture, next two digits the month of manufacturing and next 3 digits the number of machine manufactured during the particular month. Necessary drawing for the same shall be approved from RDSO. Punching of serial numbers along with name of manufacturer on ERRU box outside and inside shall also be done.

Space shall also be provided on the name plates for the purchaser to mark the Railway Administration's Code initials.

vi) The rectifier-regulator housing shall have a red coloured plate of approved design marked "Caution-Keep the cover tightly closed".

vii) Light Brown colour band 50 mm width shall be provided on the cover for visual identification of "Universal-Voltage Controller" The light Brown code No. 410 of IS:5-1994. The 50 mm band across all the sides shall be provided 50 mm above the bottom side of the cover.

viii) UVC box shall be marked with the name of manufacturer.

11.0 TESTS AND PERFORMANCE

11.1 Classification of tests

11.1.1 Prototype Tests: A prototype test is the test which is to be carried out on an ERRU declared as a prototype under the following conditions:-

a) A manufacturer undertakings to manufacture for the first time OR
b) A fundamental change in design is introduced.

11.1.1.1 The prototype tests shall be carried out at the works of the manufacturers by RDSO. Manufacturer shall submit the details of ERRU and internal type test results before offering the equipment for prototype testing.

11.1.1.2 All the following tests on the ERRU shall be conducted in conjunction with alternator of the same rating of approved make. Similarly, UVC of a make shall be tested for its performance with other capacity of ERRU in conjunction with alternator of the same rating.

The following shall constitute prototype tests:

i) Verification of overall dimensions and visual check

ii) Temperature rise test

iii) High voltage test

iv) Insulation resistance test

v) *load test

vi) *Current Limiting characteristic test

vii) *Battery Charging current limiting test.

viii) Over Voltage Protection test

ix) *Parallel operation test

x) Indication Board performance test

xi) Hose proof test

xii) Data shall be down loaded

xii) **Special Tests:**

a) Ripple content test

b) Shorting of power block diodes modules

c) Open circuiting of power block diodes

d) Computation of junction temperature

e) *Measurement of (MFO) minimum speed for full output at cold and hot condition of alternator

f) *Measurement of (MHO) minimum speed for half output

g) *Measurement of cut-in speed

h) Efficiency test

i) Short circuit protection for DC output voltage

j) Fire retardant test for terminal insulators

k) System test

l) Environmental tests

l) In order to ensure compatibility of the equipment (ERRU), the following tests shall be carried out as per relevant IEC.

i) **Electrical Fast Transient / Burst immunity test.**

The test shall be carried out as per IEC:61000-4-4.

	Power lines	**Communication and signal lines**
Pulse repetition rate	2.5 KHz	5 KHz
Voltage peak	4 KV	2 KV

ii) **Surge Test**.

The test shall be carried out as per IEC:61000-4-5. Installation class : 4, Test level : 4 KV

iii) **Electrostatic discharge**:

The test shall be carried out as per IEC-61000-4-2.

a) Enclosure conductive part – contact discharge test at 6 KV
b) Enclosure insulated part – air discharge test at 8 KV.

iv) Radiated susceptibility test – As per IEC 61000-4-3

NOTE: * These tests shall be carried out in both directions of alternators.

xiv) Earth Potential test
Body of the ERRU shall be given external voltage of 110V DC/AC. Performance of ERRU shall not get affected.

11.1.1.3 **PROTOTYPE APPROVAL**: After successful completion of the Proto-type tests as specified above, at firms' premises, the clearance shall be given by RDSO for its fitment on the coach for extensive field trails for minimum period of three months. For field trial the requisite minimum modifications in the cabling layout shall be done by the firm in consultation with Railways.

Two units of 25 kw and one unit of 4.5 kw rating shall be put on the AC & TL coaches respectively for conducting field trials.

After successful completion of field trials as reported by the Railways, the prototype approval shall be considered. The initial prototype approval of ERRU shall remain valid for two years. In case of unsatisfactory performance in the field re-prototype testing either in full or part can also be done earlier at any time by RDSO for which all the necessary facilities shall be provided by the ERRU manufacturer free of cost.

11.1.2 **TYPE TESTS**: A type test is to carried out by the manufacturer and the inspection authority on electronic rectifying-cum-regulating equipment picked up at random at the rate specified in clause 14.0 to ensure compliance with specifications in details as declared by the manufacturer and approved by RDSO.

These tests are to be carried out at manufacturer's premises. The following shall constitute type test:

i) Verification of overall dimensions and visual check

ii) Temperature rise test

iii) High voltage test

iv) Insulation resistance test

v) *Load test

vi) *Current Limiting characteristic test

vii) Battery Charging current limiting test

viii) Over voltage/Surge protection test

ix) *Parallel Operation test

x) Indication board performance test

xi) Data shall be down loaded

xii) Hose roof test

NOTE * I) These tests shall be carried out in both directions of alternators.
II) Verification of electronic component tests details shall be done as per clause no 13.11.4(B).

11.1.3 **ROUTINE TESTS:** The routine tests are to be carried out by the manufacturers at their premises on every ERRU in conjunction with alternator of the same rating to ensure compliance with specification and reliability in service.

The following shall constitute routine tests:-

i) Verification of overall dimensions and visual check

ii) Load test

iii) Battery Charging current limiting test

iv) Over voltage/Surge protection test

v) High voltage test

vi) Insulation resistance test

vii) Hose Proof test

vii) Indication board performance test

viii) Data shall be down loaded

11.1.4 **ACCEPTANCE TEST:** These tests are to be carried out by an inspecting authority nominated by the Purchaser at Manufacturer's premises to ensure compliance with the specification. Before offering the ERRU for inspection to the purchaser/inspecting officer, the in house routine test shall be sent, well in advance to the purchaser/inspecting officer by the manufacturer for scrutiny.

The following shall constitute acceptance tests:

i) Verification of overall dimensions and visual check.

ii) Temperature rise test

iii) High voltage test

iv) Insulation resistance test

v) *Load test

vi) *Current Limiting characteristic

vii) Over voltage/Surge protection test

viii) Indication board performance test

Note: Tests marked * are to be conducted in both directions of rotation.

11.1.5 The following shall constitute the in-house tests results:

i) Type test results

ii) Routine test results

The Type tests shall be done as per the sampling clause no.14.0 of this specification. The routine test shall be done on each and every ERRU by the manufacturer.

The inspecting officer can ask for repetition of any /all type/routine tests, if he so desires. Manufacturer shall furnish the details of various components used in manufacturing of ERRU and as also asked by inspecting official.

As per the declaration of the manufacturer of the ERRU rating, the above tests shall be repeated for every rating in conjunction with alternator of the same capacity. For every rating, the manufacturer, shall submit in-house test results accordingly.

11.1.6 ERRU in conjunction with alternator of the same rating shall be used on air-conditioned and conventional coaches where high reliability is to be ensured. Therefore, every equipment is to be accepted after completing all acceptance tests. The temperature rise at 2500 rev/min. will also be done on every machine. However, conducting the temperature rise test on lesser number of machines can be considered by RDSO if the production has stabilised and proper quality control is being ensured by the firm as per RDSO approved Quality Assurance Plan – Without specific permission from RDSO, this test shall not be deleted.

11.1.7 **Renewal of type test approval**

After successful prototype testing, type test approval shall be generally given for 2 years and maximum for 3 years. Manufacturer shall apply for renewal of type test approval, six months in advance before expiry of the approval. During type test renewal following information shall be given by manufacturer:

i) Any deviations from bill of material and QAP approved by RDSO earlier.

ii) Implementation confirmation of modifications issued by RDSO if any.

iii) Addition/Deletion of Machinery and Plant.

iv) Supply orders executed by the manufacturer in last 3 years. Following details should be given:

- a) P.O. No./Date
- b) Consignee and date of supply
- c) Quantity
- d) Rate (inclusive of all taxes)
- e) Warranty failures reported (nature of failure and action taken)

v) Following tests shall be carried out for revalidation of type test approval.

a) Temperature rise test

b) High voltage test

c) Insulation resistance test

d) *Load test

e) *Current Limiting characteristic

f) Battery charging current limiting test

g) Over voltage/surge protection test

h) Indication Board performance test

i) *Parallel operation test.

j) Data shall be down loaded

NOTE * I) These tests shall be carried out in both directions of alternators.

II) Verification of electronic component tests details shall be done as per clause no 13.11.4(B).

After successful completion of the above tests renewal of type approval shall be given for maximum 5 years

12.0 **TEST INSTRUMENT:** The indicating instruments used in electrical measurement shall conform to IS: 1248-1958 (Specification for Electrical Indicating instruments). Instruments with the following accuracy shall be used:

i) For prototype, acceptance and routine tests instrument of class 0.5 accuracy

ii) For surge protection test, the amplitude and duration of the surge voltage shall be measured by using digital storage oscilloscope having suitable interface with printer/PC for down loading voltage and current waveforms directly from the Oscilloscope.

13.0 **TESTS**

13.1 **VERIFICATION FOR DIMENSIONS AND VISUAL CHECK:**

This is to check the dimensions of assemblies and sub-assemblies i.e. overall dimensions of ERRU box, terminal arrangement and layout of aux. equipment as per specifications and constructional details thereof to ensure that they are consistent with good engineering practice. Inter-changeability aspects shall also be ensured.

"Sound engineering practices should be followed in the manufacturing of ERRU. Care should be taken for avoiding sharp bend to cables, ensure good welding quality with smooth finish, Use of standard hardware, avoiding sharp edges, proper bunching, routing and support to the cables."

13.2 **TEMPERATURE RISE TEST:**

13.2.1 The temperature rise test shall be conducted with the same capacity alternator and ERRU, with forced air cooling of 6m/sec. for alternator and 4m/sec. for regulator

13.2.2 The temperature rise test shall be conducted on ERRU in conjunction with alternator of different capacities at MFO and at 2500 rpm speed at rated capacity until the body temperature of alternator gets stabilised as evident from three consecutive readings of frame temperature at half an hour interval. The air velocity at location where the alternator and ERRU are to be located for tests shall be adjusted as mentioned in clause 13.2.1 prior to mounting of equipment in position. For 25 kw after each temperature rise test at MFO and 2500 rpm speed, one hour over load test shall be conducted at 222 Amps.

While conducting acceptance test, in case of 25 kw ERRU, only at 2500 rpm at rated output and one hour overload test at 222A shall be conducted whereas temperature rise test in case of 4.5 kw shall be at 2500 rpm at rated condition.

Capacity kw	Maximum speed rpm	Minimum speed rpm	Rated voltage Volts.	Rated current Amps.	One hour O/L Amps.
25kw	2500	MFO	130	193	222
4.5kw	2500	MFO	120	37.5	--

13.2.3 ERRU components temperature shall be recorded for every one hour up to four hours and there after for every half an hour readings shall be recorded. Three consecutive half an hour readings indicate stabilisation of the body temperature of alternator.

13.2.4 In the ERRU the following temperature shall be recorded

i) Diode base temperature

ii) Transformer

iii) Hall effect sensors

iv) HRC fuse

v) Bleeder Resistance

vi) Heat sink of controller

vii) Bus bar

viii) I.G.B.T. inside the Control box

ix) Ambient inside the Regular box

x) Ambient inside the UVC

13.2.5 In regard to ERRU equipment, the temperature rise of main diodes, Hall sensors, HRC fuses, bleeder resisters, current transformer, bus bars etc., shall be less than designed temperature limits of each component under worst operating conditions. The temp. rise of electronic devices being used in UVC i.e. IGBT, auxiliary diodes, auxiliary power supply module etc. shall not increase more than 30 deg. C above the ambient of 55 degree C. Inside ambient of the UVC box shall also be recorded and it shall not exceeding 30.

13.2.6 The temperature rise of power diodes, ISO-Packs, Hall Sensors, Excitation Transformer (if used), bus-bars etc. shall not be more than 50 deg. C above the ambient of 55 deg.C. There shall be consistency in the quality during lot production of the equipment whereby achieving consistency in various test parameters such as regulation, temp. rise etc.

13.3 **INSULATION RESISTANCE TEST:**

The insulation resistance shall be measured before and after high voltage test between all live terminals shorted together and body with a 500 V DC megger and these values shall not be less than 20 meg ohm for ERRU.

13.4 **HIGH VOLTAGE TEST**

Immediately after completion of heat run/performance tests, an AC potential of 1500 V rms at 50 Hz shall be applied between all live terminals shorted together and housing of the equipment. The test shall be commenced at a voltage of less than one third the test voltage and shall be increased gradually to the full test voltage. The test voltage of 1500 V for a period of 60 seconds shall be applied after conducting temperature rise test. The leakage current shall not exceed 10 mA for the above tests.

Note: During HV test, UVC may be disconnected.

13.5 **LOAD TEST:**

13.5.1 The alternator shall be run in conjunction with the ERRU of same capacity. The test shall be conducted with a resistive load and with battery. Preferably this test shall be conducted with resistive load and a battery bank of adequate capacity.

13.5.2 All performance tests shall be conducted at the set voltage of 129 V at half load of 97 A and at 126 V, at half load of i.e. 19 Amps for 25 kw and 4.5 kw respectively. The voltage setting of the ERRU shall be done at 1500 rpm after the heat run test. The alt. frame temperature shall be 40 deg. C above the ambient.

13.5.3 The test shall consist of the following:

a) No load test

b) Speed vs. output voltage characteristic test

c) Current versus voltage characteristic test

13.5.4 **BASE LOAD:**

In this test, the speed shall be varied covering the entire working range of speed and corresponding DC voltage available at equipment output terminals shall be noted. The voltage variation shall not exceed $\pm$2% of pre-set voltage for the speed range from the MFO speed to 2500 rpm. The cut-in-speed shall also be noted in this test. The speed shall be adjusted at 800, 1000, 1200, 1500, 2000 and 2500 rev/min. For 4.5 kw in addition to these speeds the test at 600 rpm as MFO shall also be done. This test shall be conducted at 10A and 1 A for 25 kw and 4.5 kw Alternator respectively as base load.

13.5.4.1 No load test at 0 A shall be conducted for the above conditions and the no load voltage shall not exceed 135 V for 25 kw and 130 V for 4.5 kw ERRU respectively.

13.5.4.2 Speed versus DC output voltage graph shall be plotted for ‘Base Load’ and ‘o’ A.

13.5.5 **SPEED VERSUS OUTPUT VOLTAGE CHARACTERISTIC TEST:**

It shall be done at overload, full rated current, 75%, 50% and 25% of full rated current. The speed shall be varied from MFO to maximum speed as per speeds mentioned Cl.13.5.4. The voltage shall not vary more than $\pm$2% of pre-set voltage for the range from the MFO speed to 2500 rpm at these loads.

Speed versus DC Output voltage graph shall be plotted for all these loads.

The overloading of ERRU shall be done as per Cl.6 of this specification.

13.5.6 **CURRENT VERSUS VOLTAGE CHARACTERISTIC TEST:**

Current versus voltage characteristic test shall be done at 1800 rev/min. The current shall be varied from 0A to rated value of 193 A for 25 kw and 0 A to rated value of 37.5 A for 4.5 kw alternators keeping the speed constant. The voltage variation shall be within $\pm$2% of the pre-set value.

The current –Vs-voltage shall be plotted for the load variation.

13.6 **CURRENT LIMITING CHARACTERISTIC TEST OF ALTERNATOR AND REGULATOR:**

13.6.1 After the current voltage characteristics test, current limiting test shall be done. At the point when the load is increased and current does not increase, the value of current shall be treated as the limit of current setting. The DC out put voltage shall not be less than 120 V at 222A load, 115 V at 40A for 25 kw and 4.5 kw respectively. The current limiting shall not exceed 230 A and 42 A for 25 kw, and 4.5 kW ratings.

The current-vs-voltage shall be plotted for the load variation including overloading of the ERRU.

Note: The difference in voltage developed in clockwise and anticlockwise direction shall not be more than 1 V during all conditions of load test and current vs voltage characteristic test..

13.7 **BATTERY CHARGING CURRENT LIMIT TEST:**

i) Total battery charging current (BCC) in AC coach shall be limited to (220$\pm$5) amps corresponding 20% of the C10 capacity of charging current i.e. 1100 x 0.2 = 220 Amps maximum), when two ERRUs are in parallel.

ii) Battery Charging Current (BCC) shall be limited to 24$\pm$ 2 Amps for 4.5 kw Regulator.

iii) BC +ve terminal shall be loaded with resistive load to check the battery charging current limits.

iv) The total load connected across the DC output and BC +ve terminal of the ERRU shall not exceed the overload rating of the alternator at any given time enroute.

v) The BC terminal voltage shall be recorded for the load variation from 0A to the battery charging limits keeping the DC +ve terminal without any load. The battery charging current versus DC output voltage shall be plotted.

vi) Total DC output current versus DC output voltage shall also be potted.

13.8 **PARALLEL OPERATION: (Only for 25 kW ERRU)**

13.8.1 This test shall be done at 800, 1800 and 2500 at 25%, 50% and 100% of full loads i.e. 386 amperes.

13.8.2 Two alternators shall run in parallel with interconnections between ERRUs.

13.8.3 Individual alternator loads and total load and bus bar voltage shall be recorded.

13.8.4 The difference of current between ERRUs shall not exceed 10 amps.

13.9 **INDICATION BOARD TEST:**

13.9.1 The indication board working shall be checked for the following:

i) Capacity of alternator

ii) Healthiness of UVC (failure status)

iii) Over voltage Protection

iv) Fuse failure

v) Overload fault

vi) Downloading of recorded data as per format given in Clause 13.9.8

* If stoppage is more than one hour - non-generation time shall not be counted and generation and non-generation time in hours shall be recorded in three digit.

13.9.2 During battery charging/discharging test, check shall be conducted to verify the Amp. Hours of discharge/charge indicated on the indication board. A discharged battery of a battery set, preferably of 1100 Ah capacity shall be charged/discharged for five hours. The indicated reading shall not vary $\pm$3% over the calculated reading.

13.9.3 Faults shall be created and failure indication shall be checked.

13.9.4 The attachment and detachment of the indication board should be checked for ease of maintenance and proper contacts. If the indication board is removed performance shall not be affected.

13.9.5 Data shall be downloaded by USB Pen Drive of reputed make OR portable data retrieval unit.

"USB pen drive shall be preferred mode of data retrieval. However, if ERRU is not compatible with USB pen drive, down loading unit with RS 232/4 pin industrial connector (female) at one end which will fit at UVC and USB port (male) at other end which will fit in PC should be supplied. Maximum size of housing shall be (L) 130 mm x (W) 80 mm x (H) 40 mm"

13.9.6 Memory shall have sufficient capacity to contain minimum 7 days data with a resolution of one minute apart from cumulative data of last 7 days and fault data. Printing option should. be available for 5/10 minute interval also.

13.9.7 Transferring of the Journey data: Normally, the data stored in the portable USB pen drive unit shall be transferred directly to the PC or laptop having USB port.

The system should be equipped with RS 232 serial port for direct down loading in to the PC/Laptop or data retrieval unit.

13.9.8 **Reporting Format**: Recording interval shall be one minute and minimum duration of recording shall be seven days. The format of reporting shall be as follows:

Format A

Date	Time	ERRU1		ERRU2	
		Output Voltage	Output Current	Output Voltage	Output Current

Charging Current	Discharging Current	Alternator RPM

Format B

Date	Time	Cumulative Charging Ah	Cumulative Discharging Ah	Generation time	Non Generation time	Distance travelled

Format C for failures

Date	Time	Type of Faults	Remarks

Types of faults which shall be recorded , preferably are as follows:

No supply from alternator or alternator failure
Over voltage generation
UVC Failure
Power circuit failure
OVP Tripped, OVP Reset
Over load
Short circuit
Battery voltage low

DISPLAY UNIT

The design of the UVC shall be provided with a provision of data logger to log both alternators DC output currents, DC voltage/battery voltage, battery charging/discharging current with respect to real time. Suitable interface shall be available enabling to down load and analyse recorded data. The UVC shall also be provided with a LCD/alpha-numeric display to indicate its various parameters as given below:

Following parameters should also be stored in the memory of micro-processor:

Parameter	Recorded every	Cumulative
Total distance travelled by the particular coach	1 hour	Yes
Alternator rpm	1 minute	No
Total generation and non generation time	1 hour	Yes
Last 32 faults recording	Actual time	No
Output voltage ERRU1	1 minute	No
Output current ERRU1	1 minute	No
Output voltage ERRU2	1 minute	No
Output current ERRU2	1 minute	No
Battery charging current	1 minute	No
Battery discharging current	1 minute	No
Charging Ah	1 hour	Yes
Discharging Ah	1 hour	Yes

Please note following points:

i) Cumulative data summary must be available at the end of journey.

ii) Output voltage will display battery voltage when train is not running.

iii) At the end of journey if waiting period is more than one hour, then that period shall not be counted as non generation time.

iv) If external charging is done then it should not be counted towards cumulative charging ampere hour.

It shall be possible to download the data ;using data downloading unit or USB stick from ERRU to PC. In case memory becomes full, earlier data should be automatically deleted and data for last seven days should be retained.

All the above parameters shall be displayed by manual selection arrangement on the display unit.

In AC coach, the above parameters should be displayed for one ERRU at a given time. It should be possible to display the above parameters for the second ERRU also through selection.

"The display should be available with the UVC inside ERRU box. For 25 KW ERRU, mounting bracket dimensions of coach indication panel shall be as per sketch No. RDSO/PE/SK/AC/0059-2003 (Rev. O) or latest" For 4.5 kW ERRU coach indication panel is not required. For 25KW CIP is required besides internal display.

Field excitation control circuit design shall be IGBT with driver control circuit to give controlled feed to the field of alternator to meet the requirements. IGBT shall be of proven design with high reliability with adequate thermal margins as mentioned above. It shall have separate heat sink for better heat dissipation.

ERRU circuit design shall not include Electro-Mechanical Static relays. Moreover Potentiometers, change over switches for voltage and current settings should not be used to achieve higher reliability. Use of Excitation Transformer/control transformer/choke etc. shall be minimum possible.

The main terminal arrangement in the terminal box of ERRU shall be generally as per RDSO's Drg.No.SKEL-3549 with latest alteration for all ratings.

"A separate battery charging terminal shall be provided in the terminal box of 4.5 KW ERRU maintaining adequate clearances keeping in view ease of maintenance. The size of additional terminal post shall also be in line with the existing design and generally conforming to RDSO's Drg. No. RDSO/PE/SK/0012-2000 (REV.0). For sensing current of battery circuit in AC Coach a standard Hall Effect Sensor shall be used. Whereas terminal arrangement of 25 KW ERRU shall be as per RDSO Drg.No. RDSO/PE/SK/AC/0011-2000 (Rev.1) or latest. "

13.9.9 **Evaluation Software**: The retrieved data can be analysed and printed through Microsoft EXCEL or the same can be analysed and printed through a special software. If special software is used, it has to be installed with every depot / workshop. Software shall give a summary of exceptions in the recorded data i.e.:-

i) How may times voltage regulation crossing 2%?

ii) How may times total current / battery charging current limit reached?

13.10 **Hose Proof Test:**

The enclosure of rectifier-regulating equipment shall be protected against ingress of solid foreign bodies and water in accordance with IS:13947. After these tests the equipment shall work satisfactorily. This shall be conducted in accordance with IP-55 of IS: 4691 with latest amendment and worked satisfactorily.

13.11 **Special Test**

13.11.1 **Ripple content test**: The voltage and current ripple content in dc output shall not exceed 2% and 10% respectively in the battery charging load and DC output at 800, 1800, 2500 rpm for 25% load, half load and full load. Ripple content shall be computed from digital storage oscilloscope having interface with the printer/PC. It shall be calculated as under:
Ripple content = (V max – V min)/ (V max + V min) x 100
Where V max = Maximum voltage
V min = Minimum voltage
To arrest the ripple suitable filter circuit may be incorporated in regulator with electronic component of highest reliability.

13.11.2 **SHORTING OF POWER DIODE**: The Alternator with Electronic Rectifier Regulator shall be run at 1800 rpm at full load with pre-setting the full load. Stop the alternator, any one power diode of the ISO-Packs shall be shorted and the alternator with rectifier regulator shall be run at 1800 rev./min. The pre-set full load shall be connected across DC output terminals for 2 minutes. After the test no component of alternator or

rectifier regulator shall get damaged. DC output voltage & current shall be recorded.

13.11.3 **OPENING OF POWER DIODE**: The alternator with electronic regulator shall be run at 1800 rpm and pre set the full load in three steps. Stop the alternator. Then any one power diode of any of he Power block diode modules shall be opened and alternator with rectifier regulator shall be run at 1800 rev./min at no load for 2 minutes and then the full load resistance shall be applied gradually in three steps and run for 2 minutes. After the test no component of alternator or rectifier regulator shall get damaged.

13.11.4 **COMPUTATION OF JUNCTION TEMPERATURE OF SEMI-CONDUCTORS USED IN ERRU**:

A) The junction temperature of power diode/ISO-Packs and auxiliary diodes shall be computed. The temperature of the junction shall not exceed 110 degree centigrade as specified in Specification No. ELRS/SPEC/SI/0015-Oct. 2001. The loading of the various electronic components and other tests shall be as per this specification.

B) Clause No. 4.1 to 4.6, 6.1 & 6.2, 7.1 to 7.11 and Annexure 7 of the specification no. ELRS/SPEC/SI/0015-Oct. 2001 shall also be complied.

13.11.5 **MEASUREMENT OF MFO SPEED AT COLD AND HOT CONDITION OF ALTERNATOR**: The Minimum speed for full output of the alternator both in cold and hot condition shall not be more than 700 rev/min. and 600 rpm for 25 kw and 4.5 kw respectively. However, MFO speed can be accepted upto 800 rpm for 25 kw alternator in special circumstances to be explained by the vendor. The test shall be done in both clock-wise and anti-clock-wise directions. Apart from measuring the cut-in speed, MHO and MFO, the characteristic curve between speed and output shall be plotted by increasing the load current at various speeds till the voltage drops to 129 V - 2 % i.e. 126.4 V.

13.11.6 **MEASUREMENT OF MINIMUM SPEED FOR HALF OUTPUT (MHO SPEED):**

i) **For 25 kW ERRU -**The alternator shall be run at a speed of 600 rev/min. The current at 130 V output setting shall be measured. It shall not be less than 50% of rated current at 600 rpm and efforts shall be made to achieve 60% of rated current. Output voltage shall be maintained within the regulation tolerance rang shall be acceptable.

ii) **For 4.5 kW ERRU -** The alternator shall be run at a speed of 500 rev/min. The current at 120 V, output setting shall be measured. It shall not be less

than 50% of rated current at 500 rpm and efforts shall be made to achieve 60% of rated current. The speed at which 50% rated current is available shall also be measured and it should not be more than 500 rpm. Output voltage shall be maintained within the regulation tolerance range shall be acceptable.

13.11.7 **MEASUREMENT OF CUT IN SPEED**: The minimum speed of alternator for cut in speed in both the directions shall be recorded. The speed shall not be more than 350 rpm (110V) for 25 kw alternator and 350 rpm (108V) for 4.5 kw alternator. However, cut-in speed can be accepted upto 400 rpm for 25 kw alternator with ERRU in special circumstances to be explained by the vendor.

13.11.8 **EFFICIENCY TEST:** The efficiency test shall be conducted at the 800, 1800 and 2500 rpm at rated load, half load and quarter load for output terminals of ERRU. Load versus efficiency curve shall be plotted for different speeds as mentioned above. The efficiency at 1800 rev/min. at full load shall not be less than 95%.

13.11.9 Efficiency test shall be done by measurement of input and output powers at the ERRU input and output terminals.

13.11.10 **OVER CURRENT (SHORT CIRCUIT) PROTECTION:** Short the DC+ DC- and BCC terminals at the Rectifier Regulator output. Run the alternator at 1800 rpm for two minutes and then increase the speed to 2500 rpm and run for two minutes.

During the test AC fuses or field fuses may blow. No damage to alternator, ERRU or UVC should occur.

13.11.11 **FIRE RETARDANT TEST FOR TERMINAL INSULATORS**: The terminal insulators of ERRU shall be tested for resistance to spread of flame in the manner given below:

A terminal post insulator shall be subjected to the luminous bat swing flame, preferably supplied by a Bunsen burner. The specimen shall be held at an angle of 45 degree to the horizontal. The flame shall be 25 mm in width across the tips. The flame shall be applied to the specimen at the lower end for 30 seconds and removed for similar period and then applied again to the same end for a second period of 30 seconds and then again removed. Should the specimen get ignited, it shall not continue to burn for more than 50 seconds after the flame has been finally removed.

13.11.11.1 **SYSTEM TESTS:** System test shall be tested conducted at ICF in presence of RDSO's representative in line with the coach condition which

will help the testing and rectification of ERRU by simulating faults. These system tests shall be done during prototype testing of the ERRU.

13.11.12 **ENVIRONMENT TESTS**: The test shall be conducted on rectifier-regulating equipment only as per IEC-60571-SECTION FIVE-TESTS", This shall include following tests:-

a. Temperature rise test (dry heat)

b. Temperature rise test (damp heat)

c. Vibration, shock and bump test.

13.11.12.1 Dry heat and damp heat test:- The dry heat and damp heat test shall be conducted on all PCBs as per latest IEC-60571.

13.11.12.2 The ERRU shall be subjected to vibration and shock testing as per IEC 61373 - 1999.

a) Random vibration test as per clause 8 Table-1 , category 1 Class B

b) Simulated long life test as per clause 9, Table-2 , category 1 Class B

c) Shock test as per clause 10, Table-3, category 1 Class B

14.0 SAMPLING AND REJECTION

The sampling for conducting various tests shall be done as per the following table:

Classification of Test		Qty. of each type of alternator covered in Purchase Order.			
		Qty. upto 49	From 50 to 149	From 150 to 299	300 and above
(a)	Prototype	As specified by RDSO			
(b)	Renewal of type approval	As specified by RDSO			
(c)	Type	1	2	3	4
(d)	Routine	All	All	All	All
(e)	Acceptance	All	All	All	All

The rejection procedure shall be adopted as given below:

Classification of Test	Stage		
	I	II	II
Prototype	The machines shall not be cleared for regular manufacturing till it passes all the tests. Quantity as specified by RDSO.		
Type	Quantity as per Cl.14	Twice the number of Alternators which failed in any of the tests at Stage I	If any alternator fails in 2nd stage. The entire lot shall be rejected.
Renewal of type approval	Quantity as per Cl.14	Twice the number of Alternators which failed in any of the tests at Stage I	If any alternator fails in 2nd stage. The entire lot shall be rejected.
Acceptance	All	All	All

If any machine fails in any of the tests and if it is considered that the nature of defect does not effect carrying out of further tests, the other tests shall be conducted. The failed machine shall be re-offered for inspection in the subsequent lot after rectification.

15.0 DRAWINGS/DESIGN DETAILS:

The quality documents (2 sets spiral bond booklet) shall be sent to RDSO for taking approval of prototype. Quality documents will consists of:-

- Design details and Circuit diagram
- Prototype test results
- ISO 9001 certificate
- Operation / Maintenance Manual
- Bill of material
- Quality Assurance Plan. This should cover following aspects

a. Organisation chart bringing out the quality control set up.

b. Qualification log sheets of the personnel manning the quality control set up.

c. Quality Assurance System: This shall cover the inspection and testing plan of following.

i. Incoming material

ii. Process control

iii. Product control

d. Details of sub-vendors.

e. Field trial report etc.

f. ERRU components' nomenclature, rating and loading.

16.0 APPROVAL BY RDSO:

16.1 The prototype ERRU shall have the approval of RDSO (Research, Designs & Standards Organisation, Lucknow-226011) before commencement of supply to Railways by manufacturing units. For this purpose the manufacturer shall submit to RDSO the results of the in house test results carried out at their works or in a recognised testing institution along with other details as per Clause 12. Notwithstanding the approval, manufacturer is wholly responsible for satisfactory service performance, life and reliability of ERRU.

The approval shall normally be valid for two years subject to satisfactory performance during the period as reported from the field. The manufacturer shall make all arrangements for undertaking field trials at their cost, if considered necessary by RDSO. For revalidation of the approval the inspecting agency may pick up/select a ERRU sample at random from the regular production at firm's premises or from the field jointly associating firm's representative.

The manufacturer shall afford all facilities to RDSO for conducting the prototype tests as per Clause 11. In case it is necessary to conduct any of the prototype tests at a testing house/institution, the full cost of such tests shall be borne by the manufacturer.

16.2 The manufacturer shall submit assembly and part drawings to RDSO for approval.

16.3 Manufacturer shall submit the details as asked for by RDSO.

16.4 Manufacturers shall not make any changes in the design of components of ERRU without approval of RDSO, Lucknow after a prototype approval of a design has been given by RDSO failing which the firm's approval may be withdrawn/withheld.

17.0 GUARANTEE AND AFTER SALES SERVICE:

17.1 Guarantee shall be as per standard IRS conditions of contract or special conditions given in the tender.

17.2 Parts failing during the guarantee period shall be repaired/replaced by the supplier free of cost within the shortest possible time after receipt of intimation. For affecting such prompt replacement, the supplier shall maintain with his service engineers posted at various stations, sufficient quantity of components and sub-assemblies. For each and every failure, a joint failure report shall be prepared by manufacturer with the Railway's representative for sending the same to RDSO's scrutiny and taking necessary inputs at their end to improve the design. Six monthly reports containing analysis of the failures and remedial measures proposed shall be circulated by the manufacturer to RDSO for which format shall be obtained from RDSO. Such failures will also be periodically reviewed by RDSO.

17.3 Type defects will continue to attract the guarantee till such type defects are fully overcome. Accordingly, the guarantee period shall get extended.

18.0 **Standardisation**

i) Inter-changeability of UVC of different ratings of same make.

ii) Inter-changeability of 4.5 kW ERRU of any make.

iii) Inter-changeability of 25 kW ERRU along with display unit of any make with standardisation of mounting and control cable.

iv) Standard arrangement for retrieval of data from the data logger.

v) Standard wiring arrangement for 25 KW ERRU I and ERRU II as per Sketch No . RDSO/PE/SK/AC/0061-2003 (Rev. 0)

19.0 **SCHEDULED MAINTENANCE**: Being an electronic system, no scheduled maintenance should be prescribed. The ERRU shall be termed as 'maintenance free' and the manufacturer shall give declaration that no scheduled maintenance is required except visual check for mounting and external damages.

20.0 **TRAINING:** The manufacturer shall undertake to train, free of cost the supervisors of the Indian Railways for operation, maintenance, fault finding, repair of the offered equipment under guidance of skilled engineers, during the first three yeas of the service of the equipment.

21.0 **INFRINGEMENT OF PATENT RIGHTS/ISO-9000 ACCREDITATION**: Indian Railways shall not be responsible for infringement of patent rights arising due to similarly in design, manufacturing process, use of similar components used in the design, development of the ERRU and any other factor not mentioned herein which may cause such a dispute. The entire

responsibility to settle any such disputes/matters lies with the manufacturer.

The firm seeking RDSO's approval for manufacture and supply of ERRUs conforming to this Specification shall have ISO-9001 accreditation or equivalent certification to ensure its conformance to Quality Systems laid down in the standard for design, manufacturing processes, raw material, testing, quality control at different stages etc.

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Bill of material of 25 KW ERRU specifying make of important items

S.N.	Description	Specification	Make
1.	ISO Packs bridge / power block diode	350 A, VRRM 1200V	• M/s IXYS • M/s International Rectifier Ltd. • M/s Hind Rectifiers Ltd. • M/s. Semikron.
2.	Field Diode	16A VRRM 1200V	• M/s IXYS • M/s International Rectifier Ltd. • M/s Hind Rectifiers Ltd. • M/s. Semikron
3.	Thyristor	-	• M/s IXYS • M/s. Semikron • M/s International Rectifier Ltd.
4.	Hall Effect Sensor	300 Amps 200 Amps	• M/s ABB • M/s LEM
5.	LCD Display	-	• M/s Oriole Electronics • Lampex • Noritek
6.	IGBT	-	• M/s IXYS, • M/s Semikron • M/s International Rectifier Ltd.
7.	Capacitor	4700 µF/450 V	• M/s EPCOS • M/s Alcon • Kendile
8.	Connector	12 pin MS 3102 F 28-18E MS 3102R28-18F	• M/s Allied • Amphenol
9.	Connector	4 pin MS 3102R 14S 4S	• M/s Allied • Amphenol
10.	HRC Fuse 160A ,16A, 10A & 6 A	-	• M/s Cooper Bussman • M/s English Electric Co. • M/s.ABB
11..	Thimble Copper all sizes	-	• Klipon • Tyco • Jenson • Dowell
12.	Control cables (Sealed Cable)		• Huber & Suhner • NEXAN • TEFKOT

Bill of material of 4.5 KW ERRU specifying make of important items

S.N.	Description	Specification	Make
1.	ISO Packs bridge / power block diode	50 A, VRRM 1200V	• M/s IXYS • M/s International Rectifier Ltd. • M/s Hind Rectifiers Ltd. • M/s. Semikron
2.	Field Diode	16A VRRM 1200V	• M/s IXYS • M/s International Rectifier Ltd. • M/s Hind Rectifiers Ltd. • M/s. Semikron
3.	Thyristor	-	• M/s IXYS • M/s. Semikron • M/s International Rectifier Ltd
4.	Hall Effect Sensor	50 Amps	• M/s ABB • M/s LEM
5.	LCD Display	-	• M/s Oriole Electronics • Lampex • Noritek
6.	IGBT	-	• M/s IXYS, • M/s Semikron • M/s International Rectifier Ltd
7.	Capacitor	2500 µF/450 V	• M/s EPCOS • M/s Alcon
8.	Connector	4 pin MS 3102R 14S 4S	• M/s Allied • Amphenol
9.	HRC Fuse 32A , 10A & 6 A	-	• M/s Cooper Bussman • M/s English Electric Co. • M/s.ABB
10.	Thimble Copper all sizes (U Type) 7003 insulated	-	• Klipon • Tyco • Jenson • Dowell

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE R&D DIVISION, VIKAS NAGAR, HYDERABAD – 500 093, AP, India

RD:MPX:F-20

General Terms and Conditions of Enquiry & Contract for the Purchase of Goods/ Services

1. The quotation and any order resulting from this enquiry shall be governed by these General Terms and Conditions of enquiry and contract for the supply of goods and the supplier quoting against this enquiry shall, unless specifically stipulates any different terms or conditions, be deemed to have read and agreed to the same.
2. Sealed quotations in double cover with tenderer's distinctive seal, superscribing enquiry number, date and due date are to be submitted so as to reach on or before due date & time, addressed to Additional General Manager(MM), Bharat Heavy Electricals Limited, Corporate Research & Development Division, Vikasnagar, Hyderabad, Andhra Pradesh, India – PIN–500 093, India to be deposited in Tender Box located at Security gate for hand deliveries.
   In the case of Two-part bid, each inner cover shall clearly be labeled as a) Technical & Commercial Bid containing technical data/ drawings/ catalogues/ quality plans along with commercial terms and conditions & copy of the price bid with the price columns left blank (unpriced price bid), b) Price bid containing prices quotes. Installation and/or Commissioning charges shall be spelt out in absolutely lucid terms, taking into account total charges, rather than quoting vaguely, such as charges per man-day or charges per engineer per day etc. If the price bid was found later to be different from the unpriced price bid in any way, the offer will be rejected summarily. The rate shall be quoted in both figures and in words.
3. Any Supplier (Agents/distributors/ representatives)desirous of quoting imported goods/ services, they should submit the quote in foreign currency along with agency agreement copy, failing which their offer is liable for rejection. In case of non-submission of agreement copy, the principal should submit quotation to BHEL directly. Foreign suppliers will also indicate in their offer Indian agent's name, if any, and address with percentage of agency commission out of the quoted price, if any. Name and Address of the supplier's Bankers address should also be given
4. Tender/ Technical bid Opening: Unless specified otherwise, tenders/ technical bids will be opened on appointed date and time as mentioned in the enquiry or as communicated changed date/time, if any, in the presence of such of those tenderers who may be present.
5. Late Tender: Tenders received after tender due date/ time (12:00 hrs) shall be treated as late tenders and will not be considered..
6. The Quotation should be free from overwriting and erasures. Corrections and additions, if any, must be attested. Incase of difference in unit price and corresponding total value or figures or words/text, the buyer (BHEL) reserves the right to select the figures or words/text leading to lowest cost to buyer.
7. Supplier should indicate in the quotation dimensions (Size), weight, rate etc., in the metric system unless the enquiry calls for different unit.
8. Validity of Quotation: All quotations shall be kept open for acceptance for a period of ninety days from the date of opening of Tenders/ Technical bid and this shall be deemed to be an express condition of all quotations.
9. In the case of Two-part bid, the vendor should furnish technical clarifications, if any, within stipulated time mentioned, failing which, it will be construed that the vendor is not interested in the tender and BHEL shall not consider the offer for further evaluation.
10. Price Impact: In the event of any bidder, after finalizing the technical specifications and scope of supply, opting to revise their original bid, they have to submit the Price-Impact only. The Original price bid along with Price-Impact bid shall be opened during pricebid opening. Unsolicited bids will not be considered.
11. Pricebid Opening: Unless specified otherwise in the enquiry, the Price bids of technically qualified vendors shall be opened with prior intimation in the presence of such of those tenderers who may be present.
12. Conformity to Specifications: The material should be of the best quality and shall be conforming to our specification given in our enquiry. Unless otherwise agreed upon by BHEL, no payment shall be due by BHEL in respect of any sample. Offers without details of specifications/ applicable catalogues will not be considered and are liable to be rejected.
13. Terms of Delivery: All Suppliers shall quote the lowest prices on EXW/ FOB/ FCA basis in case of foreign suppliers and on ex-works /Free-on-Rail/Road /F.O.R-destination basis in case of Indian/ indigenous Supplies, indicating packing & forwarding charges if any, separately.
14. Taxes and Duties: Unless specified otherwise in the enquiry, BHEL do not provide "C" Form as it is engaged in R&D. All Indian suppliers shall clearly mention current Sales Tax/ VAT, Excise Duty, and Service Tax etc, if any, payable in addition to the quoted price and indicate applicable rates/ percentage, item-wise clearly. The vendors should mention applicable Registration Number(s) specifically in their quotation. Being a research institution, BHEL R&D is exempt from Customs duty against direct imports from foreign suppliers and exempt from Central excise duty against indigenous suppliers as per Govt. of India. Hence, suppliers are requested to submit their bids clearly stating applicable taxes/ duties. The quoted taxes/ duties will be taken for cost evaluation & order placement and no change will be entertained later except in the case of changes made by the Government.
15. Insurance: Insurance will be arranged by BHEL in case of Ex-Works as well as FCA / FOB basis supplies.
16. Terms of Payment: Full payment will be made within 30 days after receipt, inspection and acceptance of the material (and where involved, Erection and commissioning of the material/ equipment at BHEL/Destination) though Electronic Fund transfer (RTGS/NEFT/SEFT) with bank charges, if any, to the supplier's account. For foreign suppliers, the preferred payment term will be on wire transfer basis and bank charges inside India will be to BHEL account and outside India will be to supplier's account.
17. Pricebid evaluation: All offers shall be evaluated based on unit price, P&F, taxes/duties, freight charges if any, loading due to non-acceptance of our standard terms. All foreign offers shall be evaluated based on monthly exchange rates announced by Customs dept., Govt. of India as applicable at technical bid opening date. Suppliers shall quote competitive price and best delivery for all the items mentioned in the enquiry. BHEL reserves the right to reject partial quotations and to place order on overall landed cost basis. Correct date of effecting supplies in the event of an order should be indicated in the offer. If the supplier's quoted terms are different from BHEL standard terms , their offers will be evaluated as per Loading factors form sent along with enquiry.
18. Packing: The supplier shall be responsible for the goods being properly and adequately packed so as to prevent any loss, damage or deterioration during transit and indicate packing charges, if any, separately.
19. Part/ Split Ordering: BHEL reserves right to Order part of the item/ quantity of the enquiry and/or split the order among qualified vendors.
20. In case the goods enquired are on Rate Contract basis with any other unit of BHEL, such fact should be clearly indicated in the quotation giving full particulars of Rate Contract number, validity and price and also your willingness to comply with order if placed against such Rate Contract. A true copy of Rate contract signed by the supplier should be sent with the quotation.
21. Inspection: On receipt, the goods shall be subjected to inspection and also test, if necessary, and our decision regarding the acceptability of the goods shall be final and binding on the suppliers.
22. Penalty for late delivery: The time stipulated for delivery of goods shall be deemed to be the essence of the contract and delivery must be completed within the stipulated date/s. In the event of supplier's failure to supply the goods by the stipulated date/s, a penalty of ½% per week for the delayed no of weeks or part thereof for the undelivered portion of PO subject to a maximum of 10% of total order value shall be levied at the discretion of BHEL.
23. Withdrawal from the Contract: In case the supplier withdraws their offer before placement of order, BHEL reserves the right not to send next enquiry(ies). In case the supplier withdraws the quotation after its acceptance by BHEL or fails to supply the goods as per the terms and conditions of contract, or at any time repudiated the contract wholly or in part, BHEL shall be at liberty to cancel the Purchase Order and to recover from the supplier the extra cost and other loss, incidentals due to the breach of contract on the part of the supplier through risk purchase.
24. Guarantee/ Warranty certificate and Manufacturer's Test report: Invariably in all cases where it is so stipulated, the supplier should furnish Guarantee/ Warranty certificate valid for a period of 18 months from date of supply or 1 year from the date of receipt, acceptance and commissioning (or more, if provide by oem) whichever earlier and manufacturer's Test report along with the goods, failing which, BHEL shall have the right to reject the goods.
25. Recovery of Dues: BHEL shall recover any amount due from the supplier or any amount outstanding to the credit of the supplier with BHEL R&D unit or any other BHEL unit(s) and/or by legal action.
26. Arbitration & Forum for Legal Proceedings: All disputes arising in connection with indigenous/ foreign supplies shall be settled through arbitration held at Hyderabad, AP, India and arbitrator shall be appointed by BHEL from the enlisted panel. The Courts at Secunderabad/ Hyderabad, AP, India shall have jurisdiction in respect of any suit or other legal proceeding arising from or relating to this contract

The rights and remedies of BHEL stated in these General terms and conditions shall be in addition and supplemental to its rights and remedies under law and custom or usage of trade or business and shall in no way be deemed to limit, curtail, supercede or derogate from its said rights and remedies.

BHEL R&D
RD:DP:MPX:F-22

LOADING FACTORS

NOTE : IN CASE OF DEVIATION TO BHEL TENDER SPECIFIED TERMS, LOADING FACTOR INDICATED IN FOLLOWING TABLE WILL BE APPLIED TO QUOTED PRICE WHILE EVALUATING THE LOWEST QUOTE ( )

A. FOR INDIGENOUS PURCHASES

SLNO	SCOPE	COMMERCIAL TERMS	BHEL STANDARD TERM	AS OFFERED	LOADING FACTOR FOR NON COMPLIANCE TO BHEL STANDARD TERMS
A.1	SUPPLY OF EQUIPMENT	PAYMENT TERMS	100% PAYMENT, WITH IN 30 DAYS FROM THE DATE OF RECEIPT AND ACCEPTANCE OF MATERIAL	**SAME**	**NIL**
				PAYMENT AGAINT PROFORMA INVOIVE / DESPATCH DOCUMENT **OR** CASH ON DELIVERY (COD) / CASH AGAINST PROOF OF DESPATCH	11% PER ANNUM INTEREST ON THE TOTAL PO VALUE FOR ONE MONTH
				ADVANCE PAYMENT WITH BANK GUARANTEE	11% PER ANNUM INTEREST ON THE TOTAL VALUE FOR OFFERED DELIVERY PERIOD (Rounded off to nearest month) + 1 MONTH
				PART ADVANCE PAYMENT WITH SUPPORTING BANK GUARANTEE AND BALANCE WITH IN 30 DAYS	11% PER ANNUM INTEREST ON ADVANCE FOR OFFERED DELIVERY PERIOD (Rounded off to nearest month) + 1 MONTH
				PART ADVANCE PAYMENT WITH SUPPORTING BANK GUARANTEE AND BALANCE ON RECEIPT OF MATERIAL	11% PER ANNUM INTEREST ON ADVANCE FOR OFFERED DELIVERY PERIOD (Rounded off to nearest month) + 1 MONTH AND 11% PER ANNUM INTEREST ON BALANCE AMOUNT FOR ONE MONTH
A.2	SUPPLY OF EQUIPMENT INCLUDING E&C	PAYMENT TERMS (THE SUPPLIER MUST SUBMITT A PERFORMANCE BANK GUARANTEE (PBG) FOR 10% OF THE BASIC VALUE OF THE ORDER VALID FOR WARRANTY PERIOD.)	90% PAYMENT, WITH IN 30 DAYS FROM THE DATE OF RECEIPTAND ACCEPTANCE OF MATERIAL . BALANCE 10% WITH IN 30 DAYS OF COMPLETION OF E&C AND ON SUBMISSION OF PERFORMANCE BANK GUARANTEE (PBG) FOR 10% OF BASIC PO VALUE.	**SAME**	**NIL**
				100% PAYMENT WITH IN 30DAYS AFTER COMPLETION OF SUPPLIES AND ERECTION AND COMMISIONING	NIL (PBG WILL NOT BE INSISTED FROM THE SUPPLIER)
				90% PAYMENT AGAINT PROFORMA INVOICE/ DESPATCH DOCUMENT **OR** CASH ON DELIVERY (COD) / CASH AGAINST DESPATCH AND BALANCE 10% WITH IN 30 DAYS OF E&C	11% PER ANNUM INTEREST ON 90% OF THE VALUE OF PO FOR ONE MONTH
				90% PAYMENT AGAINT PROFORMA / DESPATCH DOCUMENT **OR** CASH ON DESPATCH (COD) / CASH AGAINST DESPATCH AND BALANCE 10% AFTER COMPLETION OF E&C	11% PER ANNUM INTEREST ON TOTAL PO VALUE FOR ONE MONTH
				90% ADVANCE PAYMENT WITH BANK GUARANTEE AND BALANCE 10% WITH IN 30 DAYS OF E&C	11% PER ANNUM INTEREST ON 90% OF THE TOTAL VALUE FOR DELIVERY PERIOD(ROUNDED OF TO THE NEAREST MONTH) + 1 MONTH
				PART ADVANCE (x%) PAYMENT WITH SUPPORTING BANK GUARANTEE AND (90 - x) % PAYMENT ON RECEIPT OF MATERIAL AND 10% PAYMENT WITH IN 30 DAYS AFTER E&C	11% PER ANNUM INTEREST ON THE ADVANCE AMOUNT FOR THE DELIVERY PERIOD(ROUNDED OF TO THE NEAREST MONTH)+ 1 MONTH AND 11% PER ANNUM INTEREST ON (90-X)% PAYMENT FOR ONE MONTH
				PART ADVANCE (x%) PAYMENT WITH BANK GUARANTEE AND (90 - x) % PAYMENT ON RECEIPT OF MATERIAL AND 10% PAYMENT AFTER E&C	11% PER ANNUM INTEREST ON THE ADVANCE AMOUNT FOR THE DELIVERY PERIOD(ROUNDED OF TO THE NEAREST MONTH)+ 1 MONTH AND 11% PER ANNUM INTEREST ON BALANCE AMOUNT

SLNO	SCOPE	COMMERCIAL TERMS	BHEL STANDARD TERM	AS OFFERED	LOADING FACTOR FOR NON COMPLIANCE TO BHEL STANDARD TERMS
B. FOR FOREIGN PURCHASES (IMPORTED)					
B.1	SUPPLY OF EQUIPMENT	**PAYMENT TERMS.**	AGAINST SIGHT DRAFT ON PRESENTATION OF DESPATCH DOCUMENTS VIZ INVOICE, AWB ETC TO OUR BANKERS (ALL BANK CHARGES INSIDE INDIA TO BHEL ACCOUNT AND OUTSIDE INDIA WILL BE TO THE SUPPLIER'S ACCOUNT)	SAME	NIL
				100% PAYMENT AFTER RECEIPT AND ACCEPTANCE OF MATERIAL AT BHEL R&D BY WIRE TRANSFER. (DESPATCH DOCUMENTS WILL BE SENT TO BHEL R&D DIRECTLY ALONG WITH BANK DETAILS)	NIL
				LC PAYMENT	11% PER ANNUM INTEREST ON THE BASIC VALUE FOR ONE MONTH
				ADVANCE BY WIRE TRANSFER WITH BANK GUARANTEE	11% PER ANNUM INTEREST ON THE BASIC VALUE FOR DELIVERY PERIOD + 1 MONTH
				PART ADVANCE (x%) PAYMENT WITH SUPPORTING BANK GUARANTEE AND BALANCE PAYMENT AFTER RECEIPT OF MATL	11% PER ANNUM INTEREST ON THE ADVANCE AMOUNT FOR THE DELIVERY PERIOD+ 1 MONTH AND 11% PER ANNUM INTEREST ON BALANCE AMOUNT FOR ONE MONTH
B.2	SUPPLY OF EQUIPMENT INCLUDING E&C	**PAYMENT TERMS (THE SUPPLIER MUST SUBMITT A PERFORMANCE BANK GUARANTEE (PBG) FOR 10% OF THE BASIC VALUE OF THE ORDER VALID FOR WARRANTY PERIOD.)**	90% PAYMENT WILL BE MADE WITH IN 30 DAYS FROM THE DATE OF RECEIPT OF MATERIAL ON ACCEPTANCE AND BALANCE 10% WITH IN 30 DAYS OF COMPLETION OF E&C AND ON SUBMISSIONOF PERFORMANCE BANK GUARANTEE FOR 10% OF BASIC VALUE	SAME	NIL
				LC PAYMENT FOR 90% OF THE ORDER VALUE + 10% AFTER E&C WITH IN 30 DAYS	11% PER ANNUM INTEREST ON 90% OF BASIC VALUE FOR ONE MONTH
				90% OF BASIC VALUE AS ADVANCE BY WIRE TRANSFER WITH BANK GUARANTEE AND BALANCE 10% AFTER E&C BY WIRE TRANSFER WITH IN 30 DAYS	11% PER ANNUM INTEREST ON 90% OF THE BASIC VALUE FOR DELIVERY PERIOD + 1 MONTH
				x% OF TOTAL VALUE AS ADVANCE PAYMENT WITH BANK GUARANTEE AND BALANCE (I.E. 90-X)AFTER RECEIPT OF MATL BY WIRE TRANSFER AND 10% AFTER COMPLETION OF E&C	11% PER ANNUM INTEREST ON THE ADVANCE AMOUNT FOR THE DELIVERY PERIOD+ 1 MONTH AND 11% PER ANNUM INTEREST ON BALANCE AMOUNT OF 90% OF ORDER VALUE (I.E. 90-X%)
C. PERFORMANCE BANK GUARANTEE, PBG (COMMON FOR INDIGENOUS AND IMPORTS)					
C.1		**PERFORMANCE BANK GUARANTEE**	PBG FOR 10% OF THE BASIC PO VALUE SHALL BE FURNISHED IN BHEL PRESCRIBED FORMAT.	IF NOT AGREED	10% OF THE BASIC MATERIAL COST
D. PENALTY (COMMON FOR INDEGENOUS & IMPORTS)					
D.1		**LD CLAUSE**	IN THE EVENT OF DELAY IN AGREED CONTRACTUAL DELIVERY, PENALTY OF 0.5% (HALF PERCENT) PER WEEK BUT LIMITED TO A MAX OF 10% VALUE OF UNDELIVERED PORTION OF BASIC MATERIAL COST WILL BE APPLICABLE	AGREED	NIL
				IF NOT AGREED	10% OF THE BASIC MATL COST
				IF AGREED FOR 5%	5% OF THE BASIC MATERIAL COST
				OTHER THAN THE ABOVE	10% MINUS THE AGREED MAX PERCENTAGE OF THE BASIC MATERIAL COST WILL BE LOADED.

RD:MPX:F-17

BHARAT HEAVY ELECTRICALS LIMITED
CORPORATE R&D Division
Vikasnagar, Hyderabad – 500093, India.

Suppliers' compliance statement to basic conditions of enquiry
(to be submitted along with Technical & Commercial bid)

Enquiry number:: **Enquiry date::**

(In case Order to be placed on Indian supplier in Indian currency)

	BHEL R& D's terms & Conditions	**Supplier's compliance** **(indicate Yes/No. if 'No', state terms desired)**
1) Validity of offer	Unless specifically mentioned in the enquiry, 90 days from the tender opening date	
2) Delivery requirements	Free delivery at our stores or FOR destination (or as indicated in the enquiry)	F.O.R Delivery: within __ weeks from PO date
3a) Warranty	Unless specifically mentioned in the enquiry, all supplied items to be provided with warrantee for one year (or more, if provided by the OEM) from the date of acceptance/commissioning. In case of equipment involving erection and commissioning, warrantee shall be for 18 months from the date of despatch or 12 months from the date of commissioning, whichever is earlier	
3b) Manufacturer's Test report	Manufacturer's Test Report / Manufacturer's Test Certificate to be provided with Goods	
4) Terms of payment	Unless specifically mentioned, full payment will be made within thirty days after receipt, inspection and acceptance of the material at BHEL R&D (and where involved, erection and commissioning of the material/equipment at BHEL/destination), by EFT/RTGS with bank charges, if any, to supplier's account.	
5) Taxes & Duties	Unless specifically mentioned in the enquiry, we do not provide 'C' form. Supplier to specify rates of taxes/ duties element wise on the price quoted and related percentages. Please mention "NIL" if exempted and N.A if not applicable.	ED+ Cess : % Extra/ inclusive/ Nil/ NA VAT/ CST: : % Extra/ inclusive/ Nil/ NA Service Tax: : % Extra/ inclusive/ Nil/ NA
6) Penalty for late delivery	0.5% per week beyond the delivery date on undelivered portion subject to a maximum of 10% of the total order value	

* **BHEL R&D reserves the right to reject any offer due to non-compliance with the above Terms & conditions and/or non-receipt of this form in duly filled condition**
* Any other elements of cost in addition to the above may please be specified in detail.

(Signature and Stamp/Seal of Vendor)

RD:MPX:F-13

BHARAT HEAVY ELECTRICALS LTD.
Corp. R&D DIVISION
VIKAS NAGAR,
HYDERABAD- 500 093 (INDIA)
Ph: 040 – 23772704, Fax: 040 – 23770698, email: mpx@bhelrnd.co.in

VENDOR REGISTRATION FORM

(Indigenous supplier)

[FORM TO BE SUBMITTED* BY THE BIDDER ALONG WITH TECHNICAL-BID]

Before filling, please refer to instructions on page-4

1.0 VENDOR PROFILE:

1.1 Name and address of the vendor:

_____

_____

_____

Phone Nos.:
Fax No.:
Email: 1. 2.

1.2 Local representative name & address in Hyderabad/ Secunderabad:

_____

_____

_____

_____

Phone Nos.:
Fax No.:
Email:
Contact person:
Mobile No.:

2.0. TYPE OF ORGANIZATION:

PROPRIETORSHIP	COMPANY	SISTER CONCERN (mention vendor registration number of main organization)	
PARTNERSHIP	CORPORATION	Small Scale Industry	ANY OTHER (Please specify)

In case of SSI unit, copy of registration to be enclosed.

3.0 ANNUAL TURN OVER:

#	Year	Turn-Over, Rs.
1	Current Year(budgeted)	
2	Previous year (200 - 0)	
3	Prior Year (200 - 0)	

4.0 NAME AND ADDRESS OF THE BANKER:

4.1 Bank Name
4.2 Branch name
4.3 Account number
4.4 Account Type
4.5 MICR Code:
4.6 IFSC Code(RTGS/NEFT):
4.7 Bank Phone number(s),

Blank cheque, duly cancelled, to be enclosed.

Please note that all payments shall be made through Electronic clearance services to your above account against the orders executed, if any.

5.0 REGISTRATION PARTICULARS (relevant copies to be enclosed)

5.1 IT Permanent Account No.(PAN):
5.2 State sales tax/VAT Registration No.:
5.3 Central Sales Tax Registration No.
5.4 ED Registration No.
5.5 Service Tax Registration No.:
5.6 PF Account No.:
5.7 Labour Licence No.:
5.8 ESI Account No**.:**

6.0 CONTACT PERSON: S/Sri

Designation::: Phone/ Mobile No. :

7.0 TOTAL NUMBER OF EMPLOYEES:

Graduates (Engr./Scientists/ Mgmt/Fin.)	Consultants	Workers		
		Sup./Skilled	Semiskilled	Unskilled

8.0 LIST OF PRODUCTS/ SERVICES OFFERED

#	Products/ Services	Capacity
1		
2		
3		
4		
5		
6		
7		

9.0 REFERENCE LIST :

(Only recognized public and private sector companies, attach if printed copy available)

#	Customer	Volume / Year
1		
2		
3		
4		
5		
6		
7		

10.0 INFRASTRUCTURE / FACILITIES:

#	Facility (with specifications)	Age/ Year procured
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

11.0 REGISTRATION WITH OTHER BHEL UNIT/UNITS:

#	Unit	Registration No.	Year
1			
2			
3			
4			

12.0 ANY OTHER INFORMATION :

DECLARATION:

The information furnished above is true and authentic.

(CEO / PROPRIETOR)

SEAL:

DATE:

Note:

1. Registered bidders, having BHEL (R&D) registration no. or have submitted this format for registration, need not furnish this information again.
2. The competent authority reserves the right to accept or reject the registration.
3. Vendors approved for registration will be informed by mail / email, as convenient. A separate communication will be sent in case of non-registration also, citing reasons thereof.
4. BHEL reserves the right to take penal action as deemed fit if any of the information provided by the vendor(s) is found to be incorrect.
5. AGM, Head (MM) may be contacted for clarification/ additional information on registration.

Instructions

1. Fill all items. Please mention “N.A.” for items/ clauses not applicable.
2. Use A4 sheets for this document and the enclosures. Use of additional sheets is permitted if space provided is not adequate.
3. Attach copies of latest documents in respect of items 5.0 (Registration no.s)
4. Photographs of registered office and the chief executive/proprietor shall be furnished.

AUTHORISATION LETTER FOR E-PAYMENT/ NEFT / RTGS

(PLEASE FILL UP THE FORM COMPLETELY IN CAPITAL LETTERS ON YOUR COMPANY LETTERHEAD ONLY)

Type of Request (Tick one)	NEW	CHANGE

BHEL Vendor Code (to be filled by BHEL)	

1	Company Name	
2	Address	
3	City with PIN Code	
4	State	
5	PAN Number	
6	Name of Contact Person	
7	Phone no. with STD Code	
8	Fax No. with STD Code	
9	Email ID	
10	Website (URL)	

BANK DETAILS FOR EFT / RTGS

1	Bank Name	
2	Branch	
3	Branch Code	
4	Branch Address	
5	Branch Phone No.	
6	Account No.	
7	Account Type: SB/ Current/ other (Specify)	
8	MICR Code	
9	IFSC Code	

I, as an authorized representative / owner of the above named company, hereby state as under:

1. Enclosed here with a cancelled cheque in support of our company's bank details.
2. Authorize BHEL R&D Hyderabad, to electronically make payments to the designated bank account with bank charges, if any, to our account.
3. If the transaction is delayed or not effected at all for reasons of incomplete or incorrect information, I would not hold BHEL / transferring Bank responsible.
4. I hereby certify that the particulars given above are true, complete and correct.
5. This authority remains in full force until BHEL receives and acknowledge written notification requesting change or cancellation.

Date:

Authorised Signatory
Designation :

COMPANY SEAL

RD:MPX:F-18

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE R&D Division

Vikasnagar, Hyderabad, Andhra Pradesh, India – 500093

IMPORTED

Suppliers' compliance statement to basic conditions of enquiry

(to be submitted along with Technical & Commercial bid**)**

Enquiry number: **Enquiry dt:**

(In case Order to be placed on the Principal and foreign currency)

Condition	BHEL R& D's terms	Supplier's compliance (indicate Yes/No. if 'No', state terms desired)
1. Validity of offer	90 days from the tender opening date (or as per enquiry)	
2. Delivery requirements	FCA – Nearest International Airport (or as indicated in the enquiry)	F.C.A International Airport. Delivery: within __ weeks from PO date
3a) Warranty	Unless specifically mentioned in the enquiry, all supplied items to be provided with warrantee for one year (or more, if provided by the OEM) from the date of acceptance/ commissioning. In case of equipment involving erection and commissioning, warrantee shall be for 18 months from the date of dispatch or 12 months from the date of commissioning, whichever is earlier	
3b) Manufacturer's Test Report	Manufacturer's Test Report / Manufacturer's Test Certificate to be provided with Goods	
4. Terms of payment	Wire Transfer within 30 days of receipt of Material. All bank charges inside India will be to BHEL R&D account and outside India will be to the supplier's account.	
5. Agency commission	Pl specify Indian agency commission charges, if any, in percentage of quotation. The same shall be paid to the agency in Indian Currency only.	
6. Erection/Commission	As per enquiry	
7. Documentation	As per enquiry	
8. Insurance	BHEL will arrange Insurance based on intimation to our Insurance agency. Address of the agency will be mentioned in the Purchase Order.	
9. Penalty for late delivery	0.5% per week beyond the delivery date on undelivered portion subject to a maximum of 10% of the total order value.	

* BHEL R&D reserves the right to reject any offer due to non-compliance with the above conditions and/or non-receipt of this form in duly filled condition
* Any other elements of cost in addition to the above may please be specified in detail

(Signature and Stamp/ Seal of Vendor)

RD:DP:MPX:F-14

BHARAT HEAVY ELECTRICALS LTD.
Corp. R&D DIVISION
VIKAS NAGAR,
HYDERABAD- 500 093 (INDIA)

SUPPLIER REGISTRATION FORM

(FOREIGN SUPPLIER)

ALL COLUMNS SHOULD BE PROPERLY FILLED IN THE SPACE PROVIDED FOR. WHEREVER IT IS NOT APPLICABLE PLEASE WRITE "NOT APPLICABLE". INCOMPLETE OR INCORRECT FORMS MAY NOT BE CONSIDERED.

1.0 GENERAL INFORMATION:

1.1 ….NAME OF COMPANY

1.2 ….DETAILS OF HEAD OFFICE:

ADDRESS :
TELEPHONE :
FAX :
.EMAIL :
.WEB SITE :

1.3 ….DETAILS OF FACTORY/WORKS:

ADDRESS :
TELEPHONE :
FAX :
.EMAIL :
.WEB SITE :

1.4 ….DETAILS OF MARKETING AGENT

ADDRESS :
TELEPHONE :
.FAX :
.EMAIL :
.WEB SITE :

1.5 CHIEF EXECUTIVE

1.6 CONTACT PERSON(S)
FOR PRODUCT OFFERED
NAME(S)
OFFICIAL CPACITY
ADDRESS:
TELEPHONE
FAX
E-MAIL

1.7 YEAR OF ESTABLISHMENT

1.8 PRODUCTION CAPACITY PER ANNUM

1.9 PARTICULARS OF PRODUCT INCLUDING SPECIFICATION AND RANGE OFFERED FOR REGISTRTION
(Attach brouchers and catalogues)

1.10 NAME(S) OF BANKERS

1.11 BANKER'S CERTIFICATE

1.12 PORT OF LOADING

1.13 NEAREST AIRPORT

1.14 NAME OF THE INDIAN AGENT, IF ANY WITH AUTHORIZATION LETTER

2.0 FINANCIAL INFORMATION

2.1 …TOTAL CAPACITY

2.2 …ANNUAL TURN OVER FOR LAST 3 YEARS

2.3 …WHEHER CREDIT LICENSE ACCEPTABLE YES/NO

3.0 QUALITY MANAGEMENT SYSTEMS
ENCLOSED FORMAT PART-B

3.1 EXPERIENCE LIST FOR SAME/ SIMILAR ITEMS TO BE ENCLOSED

4.0 …..**FUTURE EXPANSION PLANS:**
(Give details)

5.0 LIST OF ENCLOSURES:
Including brouchers, catalogues, technical literature etc)

6.0 ANY OTHER INFORMATION

SIGNATURE OF SUPPIER (Authorized signatory)

NAME
DESIGNATION
DATE
…….OFFICIAL SEAL

Note: 1. BHEL Reserves the right to take penal action as deemed fit if any of the information provided by the vendor is found to be incorrect.
2. Please attach separate sheets, if space found is inadequate