BHARAT HEAVY ELECTRICALS LIMITED
Electronics Division
Bangalore, India

GLOBAL TENDER NOTICE NO. NKKM900005

FOR DESIGN, MANUFACTURE, SUPPLY, TESTING, COMMISSIONING, TRAINING AND TRANSFER OF TECHNOLOGY FOR IGBT BASED TRACTION CONVERTER AND 3 X 130 KVA AUXILIARY CONVERTER EQUIPMENT FOR 6000 HP ELECTRIC LOCOMOTIVES OF INDIAN RAILWAYS

1. Bharat Heavy Electricals Limited (BHEL) has been entrusted by Indian Railways for design, manufacture, assembly, testing, supply & commissioning of IGBT based traction converter and 3 X 130 KVA Auxiliary Converter suitable for fitment on 25 kV, 50 Hz, main line electric locomotives type WAG-9, WAP-5 & WAP-7 of Indian Railways. BHEL invites open tender on "Two part bid system i.e. Part-I Techno-commercial bid & Part-II Price bid" from reputed manufacturers, meeting the qualifying criteria, for the said equipment for fitment on electric locomotives. Both traction converters and 3 X 130 KVA auxiliary converters will be sourced from the same bidder and the successful bidder shall be required to transfer technology to BHEL for local manufacture of Traction Converter and 3 X 130 KVA Auxiliary Converter.

2. The qualifying criteria , Instruction to Tenderers (ITT), General Conditions of Contract (GCC) and Technical Specification can be downloaded from our website **www.bhel.com** & **www.bheledn.com**

3. Tenders as Two Part Bids, in sealed envelope, shall be received up to **1300 Hrs. on 21st July 2008**. Techno-Commercial Bids (Unpriced) shall be opened at **1300 Hrs**. on the same day in presence of tenderers who wish to attend. After evaluation of Techno-Commercial bids (Unpriced) and receipt of clarifications, if any, Price bids will be opened. Date & time of opening of Price Bids will be intimated to the technically accepted bidders.

Address for Bid Submission:

DGM / CE-MM, BHEL-EDN, Mysore Road, Bangalore – 560026, India.

DGM / CE-MM
BHEL/Bangalore, India

BHARAT HEAVY ELECTRICALS LIMITED
BANGALORE

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

BHARAT HEAVY ELECTRICALS LIMITED
ELECTRONICS DIVISION
MYSORE ROAD,
BANGALORE - 26
KARNATAKA - 560026
INDIA

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

LIST OF CONTENTS

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

SECTION I

QUALIFYING REQUIREMENTS

1. **TECHNICAL CAPABILITY**

Bidder should have designed IGBT based equipments for rolling stock applications, manufactured and supplied to any Railway network. The equipment supplied should be working satisfactorily for at least 6 months as on the date of tender opening. Experience list as per Annexure (1/QR) shall be submitted along with the Techno-Commercial bid.

2. INFORMATION TRANSFER

Bidder should be willing to transfer the information on exclusive basis to BHEL for design, manufacture, inspection, testing, commissioning, trouble shooting, servicing / maintenance, quality assurance methods etc., for the IGBT based equipments. This is expected to facilitate indigenisation of the IGBT based tendered equipment to ensure cost reduction and long-term sustenance of the equipment in India.

ANNEXURE 1/QR

PROFORMA FOR BIDDER'S EXPERIENCE

S.NO.	CUSTOMER ORDER REFERENCE & DATE	ITEM DESCRIPTION, MW RATING & CATENARY VOLTAGE	QTY	CUSTOMER'S CONTACT DETAILS • NAME • DESIGNATION • PHONE NO. • FAX NO. • EMAIL ID	YEAR OF SUPPLY/ COMMISSIONING	PERFORMANCE CERTIFICATE FROM CUSTOMER REGARDING SATISFACTORY PERFORMANCE

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

SECTION II

INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

1. BACKGROUND

1.1 Bharat Heavy Electricals Limited (BHEL) is inviting tender for design, assembly, testing & commissioning of IGBT based Traction Converter and 3 x 130 KVA Auxiliary Converter suitable for fitment on the mechanicals of existing 25 kV, 50 Hz, main line electric locomotives type WAG-9, WAP-5 & WAP-7 of Indian Railways.

1.2 BHEL invites open tender on "Two part bid system i.e. Part-I Techno-commercial Bid (Part-Ia Qualifying requirements (QR) & Part-Ib Techno-Commercial Bid (Unpriced) & Part-II Price bid " from reputed manufacturer meeting the qualifying criteria set forth in Section I of the tender, for the said equipment for fitment on electric locomotives at CLW, Chittaranjan.

2. TECHNICAL INFORMATION

2.1 The equipment offered should be in accordance with the technical specifications no. **PS/445/0044** and drawings enclosed in Section IV of the tender.

2.2 The Purchaser will accept internationally accepted alternative specifications, which ensure higher quality than the specifications mentioned in the tender specifications. However, the decision of the Purchaser in this regard shall be final. In this connection, attention of bidder is invited to the "Statement of Technical Deviations" from tender specifications (Annexure-1/ITT), which should be filled and submitted along with the offer.

2.3 The bidder shall indicate his compliance or otherwise against each clause and sub-clause of the technical specifications. The bidder shall, for this purpose, enclose a separate statement (Annexure-2/ITT) indicating compliance or otherwise of each clause and sub-clause of specifications. Whenever the bidder deviates from the provisions of a clause/sub-clause, he shall furnish his detailed justification for the same in the Statement of Technical Deviations".

2.4 The IPR (Intellectual Property Rights), if any, held by the bidder with respect to these equipment shall be made available to BHEL. BHEL shall have unrestricted rights to use the IPR held by bidder through its lifetime.

2.5 Bidder should provide the necessary information on the improvements made for the above equipment during the period of agreement.

3. BIDDER'S OTHER QUALIFYING CRITERIA

3.1 The bidder shall provide satisfactory evidence acceptable to the Purchaser to show that-

(a) he is a Supplier who has adequate technical knowledge and practical experience;
(b) he has adequate plant and manufacturing capacity to manufacture and supply for items offered within the delivery schedule offered by him;

(c) he has an established quality assurance system and organization to ensure that there is adequate control at all stages of all manufacturing process.

3.2 For purpose of para-3.1, the bidders should additionally submit-

(a) a performance statement as in Annexure- 1/QR, giving a list of major supplies, effected in the recent past, of the items offered by him, giving details of the Purchaser's name and address, order No. and date and the quantity supplied and whether the supply was made within the delivery schedule;

3.3 In addition to the above, further information regarding his capacity/capability, if required by the Purchaser shall be promptly furnished by bidder.

3.4 Bidder not submitting the requisite information may note that his offer is liable to be ignored.

4. TIME SCHEDULE

4.1 The basic consideration and the essence of the contract shall be the strict adherence to the time schedule for the supply of item/items offered.

4.2 The time and the date specified in the contract for delivery of the stores and equipment shall be deemed to be the essence of the contract and the delivery must be completed not later than the date so specified. The attention of the bidders is invited to clauses regarding liquidated damages and default in the General Conditions of Contract by which the contract shall be governed.

5. SUBMISSIONS AND OPENING OF OFFERS

5.1 All offers must be in English and typewritten. Information in any other language must be accompanied by its authenticated translation in English; failure to comply with this may render the offer liable to be rejected. In the event of any discrepancy between an offer in a language other than English and its English translation, the English translation will prevail.

5.2 Any individual (s) signing the tender or other documents connected therewith should specify whether he is signing-

(i) as sole proprietor of the concern or as are attorney of the sole proprietor;
(ii) as a partner or partners of the firm;
(iii) As a Director, Manager or Secretary in the case of a Limited Company duly authorized by a resolution passed by the Board of Directors or in pursuance of the Authority conferred by Memorandum of Association.

5.3 The original power of attorney or other documents empowering the individual or individuals to sign should be furnished to the Purchaser for verification, if required.

5.4 All prices and other information like discount etc. having a bearing on the price shall be written both in figures and words. In case of discrepancy, amount in words will be considered for evaluation.

5.5 The offers shall be submitted in two parts i.e. Part-I Techno-Commercial Bid (Part Ia – Qualifying requirements (QR) & Part-Ib Techno-Commercial Bid (Unpriced) and Part-II Price bid. Part I shall not contain any prices and similarly Part II shall not contain any technical or commercial condition having bearing on prices. The un-filled Part II - Price Bid shall be submitted with Part Ib of techno-commercial bid (unpriced).

5.6 The Offers, in separate three sealed envelopes for Part Ia, Ib, and Part II, shall be put together in one sealed envelope and submitted to BHEL, either by hand or through Post/Speed Post, so as to reach at the address given below not later than 1300 Hrs. on **21st July 2008** All the four envelopes shall be clearly marked to indicate their contents, tender number and date & time of opening of tenders.

5.7 Offer should be addressed to:

Mr. T.A.K.Nair, Mr. N.K. Kamath
DGM / CE-MM, Sr. Pur. Officer / CE-MM
BHEL-Electronics Division,
PB. No. 2606, Mysore Road,
Bangalore – 560 026, India
Phone: 0091 80 2675 8194
Mob: 0091 98451 03978
Email id: taknair@bheledn.co.in, kamathnk@bheledn.co.in

All clarifications and correspondences regarding the Tender should be addressed both the above persons.

5.8 Offers shall be as per the General Conditions of Contract given in the Bid Documents. However, the bidder shall indicate his acceptance or otherwise against each clause and sub-clause of the General Conditions of Contract. For this purpose, the bidder shall enclose a separate statement (Annexure-3/ITT) indicating only the deviations from any clause or sub clause of the General Conditions of Contract, which he proposes with full Justification for such deviations. The Purchaser, however, reserves the right to accept or reject these deviations and his decision thereon shall be final.

5.9 Each page of the offer must be numbered consecutively, should bear the tender number and should be signed by the bidder at the bottom. A reference to the total number of pages comprising the offer must be made at the top right hand corner of the first page.

5.10 The bidder should avoid ambiguity in his offer e.g. if his offer is to his standard sizes/length/dimensions, he should specifically state them in details without any ambiguity. Brief descriptions such as "standard lengths" etc. should be avoided in the offer.

5.11 The bidder shall enclose a separate statement (Annexure-4/ITT) indicating only the deviations from any clause or sub clause of the ITT, which he proposes with full justification for such deviations. The Purchaser, however, reserves the right to accept or reject these deviations and his decision thereon shall be final.

5.12 Part Ia of Techno-Commercial Bid (QR) shall be opened on 11th July. After evaluation of Qualifying requirements (Part Ia of Techno-Commercial Bid), Part-Ib of the Techno-Commercial bid (Unpriced) shall be opened and evaluated for the bidders who qualify in the QR. No clarifications shall be sought from the bidders in respect of Part-Ia of the Techno-Commercial Bid i.e. Qualifying Requirements. Techno-Commercial Bid of the qualified bidders only shall be opened. Bids not meeting the Qualifying requirements shall be returned unopened. Discussions shall be held with the qualified bidders on the Techno-Commercial Bid and clarifications/confirmation sought. Bidders shall be given an opportunity to submit supplementary price bids, if so required. Price bids of the Technically qualified Bidders will be opened, date & time for which will be intimated to the technically accepted bidders in due course of time.

6. LOCAL CONDITIONS

6.1 It will be imperative on each bidder to fully acquaint himself of all the local conditions and factors which would have any effect on the performance of the contract and cost of the stores. In his own interest, the foreign bidder should familiarize him-self with the Income Tax Act 1961, the Companies Act 1956, the Customs Act 1962 and related Laws in force in India. The Purchaser shall not entertain any request for clarifications from the bidder regarding such local conditions. No request for the change of price, or time schedule of delivery of stores shall be entertained after the offer is accepted by the Purchaser.

7. PRICE BASIS AND INDEMNITY

7.1 The bidder shall quote his prices on the basis of FOB, International Seaport / Airport.

7.2 The terms FOB shall be as defined in the latest edition of International Rules for the interpretation of the Trade Terms published by the International Chamber of Commerce, Paris and commonly referred to as INCOTERMS.

7.3 The prices should be stated only in one currency and should be either in the currency of the **bidder's country or in US Dollars**.

7.4 The prices quoted for CBU sets in Annexure of 5 ITT shall be on **Firm** basis and the balance subject to price escalation as per mutually acceptable formula to be provided by the bidder. However, the price variation shall be restricted to 3 % per annum or the actual variation as per PV formula whichever is less.

7.5 The offers should give the price breakup of major sub-assemblies under CBU, upto sub-assembly level for SKD and components level under CKD.

8. EVALUATION OF THE OFFERS

8.1 To facilitate evaluation and comparison, the Purchaser will convert all Bid Prices expressed in the amounts in various currencies in the Bid Price as payable, to Indian Rupees at the T.T. selling exchange rate of State Bank of India, New Delhi, as on the date of the price bid opening".

8.2 The tenders received will be evaluated by the Purchaser to ascertain the best and lowest acceptable tender in the interest of the purchaser, as specified in the specifications and tender documents.

8.3 The tenders received would be evaluated on the basis of Quoted FOB price.

Cargo handling charges prior to ship rails, wherever applicable, shall be to the bidder's accounts.

The tenders shall be evaluated on the total cost to BHEL as per Annexure 5 of ITT.

Terms for Training:

a) The Per day rates shall be for each calendar day of Presence of Bidder's Experts in India from and including the day they reach India to and including the day they leave India.
b) The per day rates are inclusive of Travel in and outside India, incidentals, stay and net of Indian taxes subject to DTA.
c) For each Training day on the same topic, the maximum number of participants will be limited to 5 (Five) when in Bidders' place and 10 (Ten) when in India.

9.0 BUSINESS SHARING AGREEMENT (BSA) & ORDERING OF EQUIPMENT

After evaluation of the offers, a Business Sharing Agreement (BSA) shall be entered into with the party so selected. The terms & conditions for the BSA shall be generally in line with this tender condition.

After signing the **BSA**, initial ordering will be for **5 sets CBU of Traction Converter & 2 sets CBU of Aux. Converter.**

Prototype Equipment- Out of these CBUs, 1st set of Traction Converter & 1st Set of Auxiliary converter to be supplied are referred as Prototype Equipment.
Prototype equipment are subjected to:

a) Design vetting and approval by RDSO / CLW.
b) Field Trial
c) Design modification, if any
d) Acceptance by RDSO / CLW
e) Approval for Series production

Subsequent orders will be placed after receipt of Orders from Indian Railways on successful completion of field trials & acceptance of these equipment by IR.

10. PAYMENT TERMS

1. Payment will be made in accordance with Para 12 given below.
2. Prototype set – Payment on acceptance by IR against 10% PBG for warranty period.

CBU's / SKD's/CKD's

3. CBU's/SKD are Beyond Prototype set - 100% payment upon FOB delivery against 10% PBG for warranty period.

4. CKD Components - 100% payment upon FOB delivery.

11. DEDUCTIONS

11.1 Payment as in clause 10 shall be subject to deduction of any amounts for which the Bidder is liable under the contract against this tender.

12. PAYMENT PROCEDURES

12.1 Payment will be made through Irrevocable Letter of Credits. All charges within India will be to opener's account. All charges levied by the foreign Banks shall be to beneficiary's account. The irrevocable Letter of Credits will be opened within four weeks prior to readiness of items for shipping.

13. SHIPPING ARRANGEMENTS

13.1 As the order is being placed on FOB basis, the Purchaser shall arrange sea-freight including Marine Insurance.

14. PACKING

14.1 The items tendered will have to undergo arduous transportation before reaching the destination and will have to be stored and handled in tropical climatic conditions (including monsoons) before they are put to the actual use**.** It is, therefore, imperative that packing for every item is decided by taking into consideration, inter-alia, the above vital factors, so as to eliminate damage/deterioration of items in transit/ transshipment/handling or during storage. The articles packed with raw / solid wood packing material should be treated as per ISPM – 15 and accomplished by a phytosanitory Certificate.

14.2 The specification of the packing proposed shall be indicated.

14.3 The packing advices should bring out the weight, dimensions and size of each bundles/package. Where is not possible to give weight of the bundles/packages, the contractor must indicate the volume of the bundles/packages, the number of pieces per bundle/package, number of bundles/packages, and total weight of the items supplied.

14.4 Where the materials are shipped in bundles/packages the pieces in each bundle/package should be of uniform sizes to facilitate quick acceptance and payment. The number of pieces in each bundle/package should also be the same.

15. ACCEPTANCE OF TENDER

15.1 The Purchaser may accept a tender for a part or whole of the quantity offered, reject any tender without assigning any reason and may not accept the lowest or any tender.

15.2 Acceptance of tender will be communicated by FAX, E-MAIL, Express letter direct to the bidder or through his authorized agents who should be deemed to conclude the contract.

16. EFFECT AND VALIDITY OF OFFER

16.1 The submission of any offer connected with these specifications and documents shall constitute an agreement that the bidder shall have no cause of action or claim, against the Purchaser for rejection of his offer. The Purchaser shall always be at liberty to reject or accept any offer or offers at his sole discretion and any such action will not be called into question and the bidder shall have no claim in that regard against the Purchaser.

16.2 The offer shall be kept valid for acceptance for a minimum period of **two hundred and ten (210) calendar days** from the date set for opening of Bid.

16.3 The purchaser may solicit the bidder's consent to an extension of the period of bid validity. The request and the corresponding responses shall be made in writing. A bidder granting the request will not be required or permitted to modify its tender.

16.4 Offers shall be deemed to be under consideration immediately after they are opened and until such time the official intimation of award is made by the Purchaser to the bidder. While the offers are under consideration, bidders and/or their representatives or other interested parties are advised to refrain from contacting the Purchaser by any means. If necessary, the purchaser will obtain clarifications on the offers by requesting for such information from any or all the bidders, either in writing or through personal contact, as may be considered necessary. Bidders will not be permitted to change the substance of their offers after the offers have been opened.

17. SPARE PARTS

17.1 The bidder should quote, apart from main equipment, for recommended spares required for three years of operation. The rates for such of the items of those spares should be indicated on FOB basis with complete break-up as indicated in the offer form. The Purchaser reserves the right to order any or all the spares as quoted for any quantity considered reasonable by him at the prices quoted by the bidder and on the terms and conditions quoted for the main equipment. The responsibility of the bidder under the Warranty Clause will not be diluted in any way on this account.

18. GENERAL

18.1 The bidders must ensure that the conditions laid down for submission of offers detailed in the preceding paras, are completely and correctly fulfilled. Tenders, which are not complete in all respects as stipulated above, may be summarily rejected.

19. COST OF WITHDRAWING DEVIATIONS

The bid is expected to comply with the technical specifications in entirety. However, if in the opinion of bidder, certain features can improve the performance, (i) these should be clearly brought out in "the schedule of deviations" with proper justification and
(ii) in case of non-acceptance of any specific parameter, the cost of withdrawing the deviations should be indicated in the schedule of deviations in percentage (+/-) of the equipment cost (i.e. Sl. No. 1, 2, 3 of Annexure – 5 / ITT).

Annexure-1/ITT

STATEMENT OF DEVIATIONS FROM TECHNICAL SPECIFICATIONS

Clause Number	Details of Deviations	Remarks explaining reasons for deviations and why it may be considered by the employer

Note:

1. We hereby confirm that the cost in Percentage for unconditional withdrawal of the above deviations has been given in the financial bid.
2. We hereby confirm that all implicit and explicit deviations, comments and remarks mentioned elsewhere in our proposal shall be treated as NULL and VOID and stand withdrawn.
3. We hereby confirm that but for the deviations noted in this Annexure – 1/ITT, our proposal is fully and truly compliant.
4. Deviations on the annexure of technical specifications shall also be included.

SIGNATURE OF TENDERER

Annexure-2/ITT

CLAUSE-WISE COMMENTS ON TECHNICAL SPECIFICATION

No.

Bidder shall provide clause-wise comments on the Technical Specification No.
in the following format. Comments as indicated only shall be provided.

Sl. No.	Clause Ref.	Clause Description	Comment "Complied" / "Not Complied" (see schedule of technical deviations)

SIGNATURE OF TENDERER

Note : The clause by clause comments are required to be given for the technical specifications as well as all the annexures thereof

Annexure-3/ITT

CLAUSEWISE COMMENTS ON GENERAL CONDITIONS OF CONTRACT

Bidder shall provide clause-wise comments on the general conditions of contract in the following format. Comments as indicated only shall be provided.

Sl. No.	Clause Ref.	Clause Description	Comment "Complied" / "Not Complied" (see schedule of technical deviations)

SIGNATURE OF TENDERER

Annexure-4/ITT

STATEMENT OF DEVIATIONS FROM THE INSTRUCTION TO TENDERERS

Clause Number	Details of Deviations	Remarks explaining reasons for deviations and why it may be considered by the employer

Note:

1. We hereby confirm that the cost in percentage for unconditional withdrawal of the above deviations has been given in the financial bid.
2. We hereby confirm that all implicit and explicit deviations, comments and remarks mentioned elsewhere in our proposal shall be treated as NULL and VOID and stand withdrawn.
3. We hereby confirm that but for the deviations noted in this Annexure – 4/ITT, our proposal is fully and truly compliant.

SIGNATURE OF TENDERER

PRICE SCHEDULE

Annexure 5 of ITT

TRACTION CONVERTER & AUX. CONVERTER

PRICE BID FORMAT FOR Traction Converter And Auxiliary Converter Used in WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES

TENDER NO. DATE OF OPENING.....AT .....HRS.

To,
Sr. Manager (MM),
BHEL - EDN, Bangalore, India

Item no	Description	Unit	Total Qty.	Price per Unit	Total Price	Remarks
				FOB	FOB	
EQUIPMENT - Traction Converter and Auxiliary Converter						
	a) Completely Built Unit (CBU)					
1	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	10			
2	Cooling system including blowers with motors and casing, oil / air pumps, radiators / heat exchangers for Traction Conv.(item 1)	Set	10			
3	IGBT based Auxiliary Converter /Inverter & controls	Set	10			
	Sub-Total	A				
	b) Semi Knocked Down (SKD)					
4	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	15			
5	Cooling system including blowers with motors and casing, oil / air pumps, radiators / heat exchangers for Traction Conv.(item 1)	Set	15			
6	IGBT based Auxiliary Converter /Inverter & controls	Set	15			
	Sub-Total	B				
	c) Completely Knocked Down (CKD) - components					
7	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	15			Refer Annexure 6 of ITT for the explanation of quantity (15).
8	IGBT based Auxiliary Converter /Inverter & controls	Set	15			
	Sub-Total	C				
	OTHERS					
SL NO	Item Description	Unit	Quantity			
1	Development charges and documentation charges if any	Set	1	-		To be included in a),b) and c) excluding cooling system.
2	Supply of Drawings & documents for mechanical modifications, if required.	Set	1	-		
3	Training charges at Bidder's place for 300 mandays for design, assembly, testing, commissioning, O&M, trouble-shooting, SW parameter setting, Root Causes Analysis	Man day	300	-		
4	Deputation of experts for 60 days for Erection, Commissioning, Field Trials & Approvals	Man day	60	-		
5	Software tools along-with 2 nos. laptop computers.	Set	1			OPTIONAL ITEMS
6	Special tools and tackles, test equipment including SW, if any, etc.for assembly,testing, commissioning, trouble	Set	1			
7	Any other equipment required (Details to be furnished) *	Set	1			
8	Spares for 3 years maintenance during warranty/beyond warranty *	Set	1			
	LEVIABLE TAXES and DUTIES	D				

Grand Total (A+B+C+D)

While evaluating the Prices for Sl. No. 1, 2 & 3, the Prices will be loaded for a) Longer Delivery Quoted & b) Cost of Withdrawing Deviation

Overall lowest evaluated cost of (A+B+C+D) to BHEL will be considered for selecting the successful bidder.

SIGNATURE OF TENDERER

NOTES

1. "Shall not be considered for evaluation of offers.
2. No change in the Format is permissible and the bidders are required to quote in this Format only.
3. Bidder has to necessarily quote for Optional items, however this will not be taken for evaluation
4. Prices indicated in FOB column to be mentioned both in figures & words.
5. The tender documents should be read thoroughly before submitting the prices.
6. Itemized Prices for Traction Converter and Auxiliary Converter to be separately indicated for CBU, SKD & CKD Options
7. Bidder not to include taxes , duties, levies etc. payable in Indian Territory which shall be borne by BHEL
8. Technology transfer documents shall be supplied during the delivery and manufacture of first 20 sets as indicated in annexure 5 of ITT. **This is mandatory condition without which the bid will be considered unresponsive and rejected without any evaluation.** The exact phasing shall be decided with the successful bidder.
9. CBU - **Completely built unit**, manufactured, assembled, tested at bidders premises. trail
10. **SKD - Semi knocked down units.** All sub assemblies including hardware and consumables to be supplied for the final assembly and testing of the equipment at purchasers premises.
11. **CKD - Completely knocked down units.** All components including hardware and consumables to be supplied for the assembly & testing of sub-assembly, final assembly and testing of the equipment at purchasers premises. The Phase wise indeginisation will be attempted at this stage. The tentative Phasing is indicated in **Annexure - 8 of ITT.** While calculating the quantity indicated for item 7 & 8, the Bidders contribution in each Phase (in Percentage) and corressponding Quantity are multiplied and summed up.

SIGNATURE OF TENDERER

Annexure 6/ITT

Details of localisation for IGBT based propulsion system

1	2	3	4	5	6	7
Description	5 Sets of TC & 2 Sets of AC	6 -10 Sets of TC and 3 - 10 Sets of AC	11 - 25 Sets of TC and AC	26 - 40 Sets of TC and AC	41-70 Sets of TC and AC	71-100 Sets of TC and AC
Time frame	2009-10	2011-12	2012-13	2013-14	2013-14	2014-15
Quantity - Traction Converter (TC)	5	5	15	15	30	30
Quantity - Auxiliary Converter (AC)	2	8	15	15	30	30
%age of Bidder Contribution				30%	20%	15%
Traction converter & controls	CBU	CBU	SKD	Please refer to Annexure 5 / ITT		
Auxiliary converter & controls	CBU	CBU	SKD			

NOTES:

a) The TC and AC quantity indicated in Columns 3 to 7 is tentative and may change.

b) Scope of supply for prototype equipments shall consist of design of equipment; Modifications in existing mechanical design, if any; Design approval from RDSO; Manufacturing of equipment; Equipment testing; System testing at bidder's works; Assistance in erection & commissioning of equipment on loco at CLW; Association in field trials; Modifications, if any and Acceptance by IR.

c) Scope of supply for CBUs shall consist of Manufacturing & testing of equipment; Assistance in erection & commissioning at CLW.

d) To achieve the localisation the transfer of information shall be as per Annexure 12 of Technical Specification

e) Scope of supply of SKD units shall consist of Manufacturing & supply of major sub-assemblies as defined in attached annexures 1.

f) The quantity for CKD Components as indicated in Annexure -5 of ITT is arrived as follows: The quantity in Columns 5 - 7 are multiplied by Respective % age of Bidder portion, (i.e. 0.30*15 + 0.20*30 + 0.15*30 = 15).

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

SECTION III

GENERAL CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

1. DEFINITIONS

Throughout these conditions and in the specifications, the terms: -

(i) "The Purchaser" means Bharat Heavy Electricals Limited, Electronics Division, Bangalore unless the context otherwise provides.
"The inspecting officer" means the person, firm or department nominated by the Purchaser to inspect the stores on his behalf and the Deputies of the Inspecting Officer so nominated.

(ii) "The Contractor" means the firm or company with whom the order for the supply is placed and shall be deemed to include the Contractor's successors (approved by the Purchaser), representatives, heirs, executors and administrators, as the case may be, unless excluded by the terms of the contract.

(iii) "Contract" means and includes the bid invitation, instructions to tenderers, general conditions of contract, acceptance of tender including advance acceptance of tender, , particulars and other conditions specified in the, the agreement entered into between the Purchaser and the contractor including all attachments and Appendices there to and all documents incorporated by reference therein, which has been accepted or acted upon by the contractor and a formal agreement, is executed.

2. EXECUTION

The whole contract is to be executed in the most approved, substantial and workman like manner, to the entire satisfaction of the Purchaser or his nominee, who, both personally and by his deputies, shall have full power, at every stage of progress, to inspect the stores at such times as he may deem fit and to reject any of the stores, which he may disapprove, and his decision thereon and on any question of the true intent and meaning of the specification shall be final and conclusive.

3 RESPONSIBILITY OF THE CONTRACTOR FOR EXECUTING CONTRACT

3.1 **Risk in the Stores**- The contractor shall perform the contract in all respects in accordance with the terms and conditions thereof. The stores and every constituents part thereof, whether in the possession or control of the contractor, his agents or servants or a carrier, or in the joint possession of the contractor, his agents or servants and the Purchaser, his agents or servants, shall remain in every respect at the risk of the contractor until their actual delivery to the consignee at the stipulated place or destination or where so provided in the contract. The contractor shall be responsible for all loss, destruction, damage or deterioration of or to the stores from any cause whatsoever while the stores after approval by the inspector are awaiting dispatch or delivery or are in the course of transit from the contractor to the consignee.

3.2 **Consignee's Right of Rejection**

(i) Notwithstanding any approval which the Inspector may have given in respect of the stores or any materials or other particulars or the work or workmanship involved in the performance of the contract (whether with or without any test carried out by the contractor or the inspector or under the direction of the Inspector and notwithstanding delivery of the stores where so provided, it shall be lawful for the consignee, on behalf of the Purchaser, to reject the stores or any part, portion of consignment thereof within **90 days** after actual delivery thereof to him at the place or destination specified in the schedule, if such stores or part/portion of consignment thereof is not in all respect in conformity with the terms and conditions of the contract whether on account of any loss, deterioration or damage before despatch or delivery or during transit or otherwise how-so-ever..

(ii) The provisions contained in the clause-21 relating to the removal of stores rejected by the Inspector shall, *mutates mutandis*, apply to stores rejected by the consignee as herein provided.

4 INDEMNITY

4.1 The contractor shall at all times indemnify the Purchaser against all claims which may be made in respect of the said work for infringement of any right protected by patent registration design or trade mark; provided always that in the event of any claims in respect of an alleged breach of a patent registered or trade mark being made against the Purchaser he shall notify the contractor of the same and the contractor shall be at liberty, but at his own expense, to conduct negotiations for settlement or any litigation that may arise there from.

5 PRICES

5.1 The prices stated should include all costs of stamping, painting, marking, protection or preservation of the stores and any claim what-so-ever that may arise from the manufacture, packing, shipment, marking and/or delivery of stores in accordance with those consideration and include payment by the contractor of Dock and Harbour dues, port charges, export taxes and other fees or charges, if any, levied because of exportation. The prices stated are also to include all rights (if any) of patent, registered design or trade mark and the contractor shall indemnify the Purchaser against all claims in respect of the same.

6 TRANSFER AND SUBLETTING

6.1 The contractor shall not sublet (otherwise than that which may be customary in the trade concerned), transfer, assign or otherwise part with directly or indirectly to any person or persons, whatever is in this contract, or any part thereof without the previous written permission of the Purchaser or his nominee.
The contractor shall be entirely responsible for the work executed by the sub-contractors, if any, to the entire satisfaction of the inspection organisation nominated by the Purchaser.

7 DRAWINGS

7.1 If any dimensions figuring upon a drawing differ from those obtained by scaling the drawings, the figured dimensions shall be taken as correct.

8 ALTERATIONS

8.1 The Purchaser or his nominee may require such alteration to be made on the work, during its progress, as he deems necessary. Should these alterations be such that either party to the contract considers an alteration in price justified, such alteration shall not be carried out until amended prices have been submitted by the contractor and accepted by the Purchaser. Should the contractor proceed to manufacture such stores without obtaining the consent in writing of the Purchaser to an amended price, he shall be deemed to have agreed to supply the stores at such price as may be considered reasonable by the Purchaser.

9 PROGRESS REPORT

9.1 The contractor shall render such reports as to the progress of the contract and in such form as may be called for by the Purchaser or his nominee. The submission and acceptance of these reports shall not prejudice the right of the Purchaser in any manner.

10 MARKING

10.1 The marking of all goods supplied shall comply with the requirement of the Indian Acts relating to merchandise marks or any amendment thereof and for the rules made there under. The following marking of the materials is required :

(a) The following particulars should be stencilled with indelible paint on all the materials/packages:
(i) Purchase order number
(ii) Item number & description
(iii) Port consignee
(iv) Abbreviated consignee marks

(b) The marking as in (a) above should be on labels securely clamped to the packages or bundles so as not to break loose during transit. The use of steel tags for this purpose should be avoided.
(c) In addition to the marking as specified above, distinguishing colour marks should be given so as to distinguish the ultimate consignee in India.

11 PACKING

11.1 The contractor will be held responsible for the stores being sufficiently and properly packed so as to ensure their being free from any loss or injury on arrival at their destination.

11.2 Where materials are to be supplied in bundles, the gross weight should not exceed 1.9 metric tonne per bundle for shipments to Indian Ports.

12 SUPPLY OF DRAWINGS, TRACINGS AND SPECIFICATIONS

12.1 Any drawings, tracings or descriptions specified shall, unless otherwise directed, be furnished by the contractor with the first consignment of the work to which they relate and no payment whatsoever will be made until such drawings, tracings or descriptions have been furnished to the satisfaction of the Purchaser.

13 CORRUPT GIFTS AND PAYMENTS OF COMMISSION

13.1 Any bribe, commission, gift or advantage given, promised or offered by or on behalf of the contractor, his agents or servants, or any one on his/their behalf to any employee, representative of the Purchaser or any person on his behalf in relation to the execution of this or any other contract with the Purchaser shall, in addition to the criminal liability under the laws in force, subject the contractor to cancellation of this and all other contracts with the Purchaser, and also to payment of any loss resulting from any such cancellation to the like extent as is provided in case of cancellation under clause 'DEFAULT' given below and the Purchaser shall be entitled to deduct the amounts so payable from any money otherwise due to the contractor under this or any other contract. Any question or dispute as to the commission of any offence under the present clause shall be settled by the Purchaser in such manner and on such evidence or information as may be thought fit and sufficient and his decision shall be final and conclusive on the matter.

14 DELIVERY PERIOD

14.1 The Purchaser attaches the utmost importance to timely deliveries and requests the manufacturers to take note of the liquidated damages as are applicable in case of delays in supplies. The required delivery is as below:

Milestone	**Completion**
TRACTION CONVERTER and AUXILIARY CONVERTER	
Submission of Design & Drawings	1 Months
Approval of Drawings by BHEL / RDSO	3 Months
Supply of Prototype Equipment (1st Set) for Aux. Converter	7 Months
Supply of Prototype Equipment (1st Set) for Traction. Converter	9 Months
Supply of balance Set for **Auxiliary Converter (2nd Set of CBU)**	8 Months
Completion Field Trials for Traction & Auxiliary Converter	13 Months
Supply of balance Set for **Traction Converter (4 Sets of CBU)**	19-20 Months

The above period shall be counted from the date of issue of LOI / Purchase Order whichever is earlier. The delivery mentioned above is FOB delivery. In case Bidder is offering higher delivery for equipment, the corresponding Equipment Prices will be

loaded with 2% per month for each extra month of delivery or part thereof upto a maximum of 10% for evaluation purpose.

15 LIQUIDATED DAMAGES

15.1 In the event of delay in agreed contractual delivery of CBU's, SKDs and CKDs as indicated in respective Purchase orders, a penalty at the rate of 0.5 % (half per cent) per week or part thereof but limited to maximum of 5% of the Contract Value.

16 WARRANTIES

16.1 The bidders shall be responsible for any damage of the equipments supplied due to defective design, materials and workmanship for the period as given below:

Prototype set – 42 months from date of commissioning or 48 months from FOB dely.whichever is earlier.

Other CBU / SKD sets – 36 months from date of commg. Or 42 months from FOB dely. whichever is earlier.

CKD components – 36 months from date of commg. Or 42 months from FOB dely. whichever is earlier.

The bidder shall replace all such equipment supplied during the warranty period at his own cost. The bidder shall warrant that everything to be furnished hereunder shall be free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and consistent with established and accepted standards of material of the type ordered and in full conformity with specifications and drawings. The bidder's liability in this respect of any complaints, defects and / or claim shall be limited to the furnishing and installation of replacement parts free of any charge. The warranty clause in commercial agreement, if any, will prevail.

17 FORCE MAJEURE

17.1 In the event of any unforeseen event directly interfering with the supply of stores arising during the currency of the contract, such as insurrection, restraint imposed by the Govt. act of legislative or other authority; war, hostilities, act of the public enemy, civil commotion, sabotage, fire, floods, explosions, epidemics, quarantine restriction, strikes, lockouts, or act of God, the contractor shall, within a week from the commencement thereof, notify the same in writing to the Purchaser with reasonable evidence thereof . If the force majeure condition(s) mentioned above be in force for a period of 90 days or more at any times, the Purchaser shall have a right to terminate the contract on expiry of 90 days of commencement of such force majeure by giving 14 days notice to the contractor in writing. In case of such termination, no damages shall be claimed by either party against the other, save and except those, which had occurred under any other clause of this contract prior to such termination.

18 PERFORMANCE GUARANTEE BOND (PBG)

18.1After order is issued by the Purchaser; the Contractor shall furnish a Performance Guarantee Bond in the Proforma attached in Annexure 1/GCC on the following lines.

a) Bank Guarantee shall be kept valid till the end of warranty period (Refer Cl. 16)

b) Bank Guarantee from any Consortium Bank as per Annexure 2 Only are acceptable.

c) If Bank Guarantee is from any Nationalised Banks other than the Consortium Bank, the BG's is acceptable, if BG's are enforceable in Bangalore.

d) If Bank Guarantees are issued by Foreign Bank the same has to be confirmed by our Consortium Bank in India as per Annexure 2 of GCC

.

d) The Bank Guarantees should be sent by the concerned bank directly to BHEL-Electronics Division addressed to the concerned Purchase Executive who has placed the order.

BG's should be received within 15 days from the receipt of the letter of acceptance of the tender by the contractor or the execution of the contract, whichever is earlier, for an amount equivalent to 10% of the value of the contract in the same currency of the contract price. All the expenses to be incurred for issue of BG shall be borne by the contractor. Performance and completion of the contract in all respects the Performance Guarantee Bond will be returned to the Contractor without any interest. In case furnishing of an acceptable Performance Guarantee Bond is delayed by the contractor beyond the period provided above and Bond is accepted by the Purchaser, liquidated damages, as provided in clause-15 for the period of delay in submission of the Bond, may be levied.

18.2 The performance Guarantee Bond shall remain in full force and effect during the period that would be taken satisfactory performance and fulfilment in all respects of the contract i.e. till satisfactory commissioning of the equipment and proving during field trials which ever is later, and shall in the first instance be valid up to twelve months after the above date provided that before the expiry of the date of validity of the Performance Guarantee Bond, the Contractor on being called upon by the Purchaser from time to time, shall obtain from the Guarantor Bank, extension of time for validity thereof for a period of six months, on each occasion. The extension or extensions aforesaid, executed on non judicial stamp paper of appropriate value must reach the purchaser at least thirty days before the date of expiry of the Performance Guarantee Bond on each occasion. Expenditure towards extension/s of PBG shall be borne by the contractor.

18.3 As and when an amendment is issued to the contract, the contractor shall, within fifteen days of the receipt of such an amendment furnish to the Purchaser an amendment to the Performance Guarantee Bond rendering the same, valid for the contract as amended.

18.4 This Performance Guarantee Bond and/or any amendment thereto shall be executed on a stamp paper of requisite money value in accordance with the laws of the country in which the same is/are executed by the party competent to do so, The Performance Guarantee Bonds executed in India shall also be got endorsed by the Collector under Section 32 of the Indian Stamp Act, 1899 for adequacy of the Stamp Duty, by the contractor.

19 INSPECTION

19.1 Inspection will be carried out by the Purchaser or his nominee. The cost of the inspection will be on Purchaser's account subject to other provisions herein contained. At least **four weeks notice** must be given to the inspecting authority to enable him to arrange the necessary inspection.

19.2 **Facilities for Test and Examination**

(i) The contractor shall provide, without extra charge, all materials, equipment, tools labor and assistance of every kind which the Purchaser or his nominee may consider necessary for any tests and examinations, which he or his nominee shall require to be made on the contractor's premises and shall pay all costs attended thereon.

(ii) The contractor shall also provide and deliver free of charge, at such places as the Purchaser or his nominee may nominate, such materials as he or his nominee may require for test by chemical analysis or independent testing machines/laboratories. The cost of any such tests will be defrayed by the purchaser unless it is stated in the specification that it is to be paid by the contractor.

19.3 **Notification of Result of Inspection**

Unless otherwise provided in the specifications the examination of stores will be made as soon as practicable after the same have been submitted for inspection, and the result of the examination will be notified to the contractor.

19.4 **Inspection Notes**

On the stores being found acceptable by the Inspecting Officer, he shall furnish the contractor with necessary copies of the Inspection Notes duly completed, for being attached to the contractor's bill in support thereof.

19.5 **Certification of Inspection and Approval**

(i) No Stores will be considered ready for delivery until the Purchaser or the Inspecting Officer nominated by him shall have certified in writing that those have been inspected and approved by him.

(ii) It shall be the responsibility of the contractor to ensure that only such goods as have been duly inspected and approved by the Inspecting Authority are offered for arranging shipment to the Government of India Forwarding Agents (as and if applicable) and to furnish to them a certificate as under:-

"Certified that the goods offered for arranging shipment have been duly inspected and approved by the prescribed in accordance with the terms of the contract a copy of the Inspection Certificate issued in this regard is enclosed."

20 INSPECTING OFFICER-POWER OF REJECTION

20.1 **The Inspecting Officer shall have the power: -**

(i) Before any Stores or part thereof submitted for inspection, to certify that they cannot be in accordance with the contract owing to the adoption of any unsatisfactory method of manufacture.
(ii) To reject any Stores submitted as not being in accordance with the specifications.
(iii) To reject the whole of the installment tendered for inspection, if after inspection of such portion thereof, as he may in his discretion think fit, he is satisfied that the same unsatisfactory.
(iv) To mark the rejected stores with a rejection mark, so that they may be easily identified if re-submitted.

20.2 The Inspecting Officer's decision as regards the rejection shall be final and binding on the contractor.

21 CONSEQUENCES OF REJECTION

21.1 If on the Stores being rejected by the Inspecting Officer or consignee at the destination, the contractor fails to make satisfactory supplies within the stipulated period of delivery, the purchaser shall be at liberty to: -

(i) Request the contractor to replace the rejected stores forthwith but in any event not later than a period of 21 days from the date of rejection and the contractor shall bear all the cost of such replacement, including freight, if any, on such replacing and replaced stores but without being entitled to any extra payment on that or on any other account.
(ii) Purchase or authorize the purchase of quantity of the stores rejected of others of a similar description (when stores exactly complying with the particulars are not, in the opinion of the Purchaser, which shall be final; readily available) without notice to the contractor, at his risk and cost and without affecting the contractor's liability as regards to the supply of any further installment due under the contract, or
(iii) Cancel the contract and Purchase or authorize the Purchase of the stores or others of a similar description (when stores exactly complying with the particulars are not, in the opinion of the Purchaser, which shall be final readily available) at the risk and cost of the contractor; In the event of action being taken under sub-clause (ii) above or this sub-clause, the provisions of clause-15 of the General Conditions of Contract shall apply as far as applicable.

21.2 Where, under a contract, the price payable is fixed on F.O.B. port of export, the contractor shall, if the stores are rejected at the destination by the consignee, be liable in addition to his other liabilities including refund of price recoverable in respect of the

stores so rejected, to reimburse to the purchaser, the freight and all other expenses incurred by the Purchaser in this respect.

21.3 Rejected Stores

On rejection of any stores submitted for inspection at a place other than the premises of the contractor, such stores shall be removed by the contractor at his own cost, subject as hereinafter stipulated, within 14 days of the date of intimation of such rejection. If the concerned communication is addressed and posted to the contractor at the address mentioned in the schedule, it will be deemed to have been served on him at the time when such communication would in course of ordinary post reach the contractor. Provided that the Inspector may call upon the contractor to remove dangerous, infected or perishable stores within 48 hours of the receipt of such communication and the decision of the Inspector in this behalf shall be final in all respects. Provided further that where the price or part thereof has been paid, the consignee is entitled without prejudice to his other rights to retain the rejected stores till the price paid for such stores is refunded by the contractor and that such retention shall not in any circumstances be deemed to be acceptance of the stores or waiver of rejection thereof.

21.4 All rejected stores shall in any event and circumstances remain and always be at the risk of the contractor, immediately on such rejection. If such stores are not removed by the contractor within the periods aforementioned, the Inspector may remove the rejected stores and either return the same to the contractor at his risk and cost by such mode of transport as the Purchaser or the inspector may decide, or dispose off such stores at the contractor's risk and on his account and retain such portion of the proceeds, if any, from such disposal, as may be necessary to recover any expense incurred in connection with such disposals (or any price refundable as a consequence of such rejection). The Purchaser shall in addition, be entitled to recover from the contractor, the handling and storage charges for the period during which the rejected stores are not removed/disposed off in accordance with the provisions thereof.

22 ACCEPTANCES OF STORES DESPATCHED AFTER EXPIRY OF DELIVERY PERIOD.

22.1 In cases where only a portion of the stores ordered is tendered for inspection at the fag end of the delivery period and also in cases where inspection is not completed in respect of the portion of the stores tendered for inspection during the delivery period because of the reason that adequate notice for inspection in accordance with clause-21 of General Conditions of Contract was not given by the contractor, the Purchaser reserves the right to cancel the order for the balance quantity, at the risk and expense of the contractor without any further reference to him. If the stores tendered for inspection during or at the fag end of the delivery period are not found acceptable after carrying out the inspection, the Purchaser is entitled to cancel the contract in respect of the same at the risk and expense of the contractor. If however, the stores tendered for inspection are found acceptable, the Purchaser may grant an extension of the delivery period subject to the following conditions: -

(a) The Purchaser has the right to recover from the contractor the liquidated damages on the stores, which the contractor has failed to deliver within the period fixed for delivery.

(b) That no increase in price on account of any statutory increase in or fresh imposition of Customs Duty, Excise Duty, Sales Tax, Freight Charges or on any account of any other tax or duty leviable in respect of the stores specified in the contract, which takes place after the date of delivery period stipulated in the said Acceptance of Tender shall be admissible on such of the said stores as are delivered after the said date.

(c) That notwithstanding any stipulation in the contract for increase in price on any other ground no such increase which takes place after the delivery date stipulated in the contract shall be admissible on such of the said as are delivered after the said one.

(d) But nevertheless the purchaser shall be entitled to the benefit of any decrease in price on account of reduction in or remission of Customs Duty, Excise Duty, Sales Tax or on account of any other ground which takes place after the expiry of the above mentioned date namely the delivery date stipulated in the contract. The contractor shall allow the said benefit in his bills or in the absence thereof shall certify that no decrease in price on account of any of these factors has taken place.

22.2 The contractor shall not despatch the stores till such time an extension in terms of clause 22.1 (a) and (b) above is granted by the Purchaser and accepted by the contractor. If the stores are dispatched by the contractor before an extension letter as aforesaid is issued by the Purchaser and the same are accepted by the consignee, the acceptance of the stores shall be deemed to be subject to the conditions (a) and (b) mentioned in clause-22.1 above.

22.3 In case where the entire quantity has not been tendered for inspection within the delivery period stipulated in the contract and the Purchaser chooses to grant an extension of the delivery period, the same would be subject to conditions (a) and (b) mentioned in clause-22.1 above.

23 ARBITRATION

23.1 **For Foreign Contractor**

In the event of any dispute or difference arising between the parties hereto relating to any matter arising out or connected with this agreement, such dispute or difference shall be referred to the award of two Arbitrators, one Arbitrator to be nominated by the Purchaser and the other to be nominated by the contractor or in the case of the said Arbitrators not agreeing, then to the award of an Umpire to be appointed by the Arbitrators in writing before proceeding with the reference, and in case the Arbitrators cannot agree to the Umpire, who may be nominated by the Chief Justice of India. The award of the Arbitrators, and in the event of their not agreeing, of the Umpire appointed by them or by the Chief Justice of India, shall be final and binding on the parties. Subject as aforesaid, the Indian Arbitration and Concilation Act, 1996 the rules there under and any statutory modification or re-enactment thereof, shall apply to the arbitration proceedings under this agreement. The venue of the arbitration in all cases shall be in India. Language of arbitration proceedings shall be English.

23.2 In the event of the death of an arbitrator, neglecting or refusing to act, or resigning or being unable to act for any reason or his award being set aside by the court for any reason, it shall be lawful for the authority appointing the arbitrator to appoint another arbitrator in place of the outgoing arbitrator in the manner aforesaid.

23.3 The arbitrator may from time to time, with the consent of all the parties to the contract enlarge, the time for making the award.

23.4 Upon every and any such reference, the assessment of the cost incidental to the reference and award respectively shall be at the discretion of the arbitrator.

23.5 Subject as aforesaid, the Indian Arbitration and Concilation Act, 1996 and the rules there under and any statutory modification thereof, for the time being in force, shall be deemed to apply to the arbitration proceedings under this clause.

23.6 Work under the contract, if reasonably possible, may continue during the arbitration proceedings an no payment due to or payable by the Purchaser shall be withheld on account of such proceedings.

23.7 The venue of arbitration shall be the place from which the acceptance note is issued, or such other place as the arbitrator at his discretion may determine.

23.8 In this clause the authority to appoint the arbitrator includes, if there be no such authority, the officer who is, for the time being discharging the functions of the authority, whether in addition to other functions or otherwise.

24 LAWS GOVERNING THE CONTRACT

24.1 This contract shall be governed by the laws of India for the time being in force.

24.2 Irrespective of the place of delivery, the place of performance or place of payment under the contract, the contract shall deemed to have been made at the place in India from where the contract has been issued.

25 JURISDICTIONS OF COURTS

The courts of the place from where the contract has been issued shall alone have jurisdiction to decide any dispute arising out of or in respect of the contract.

26 HEADINGS

26.1 The headings of conditions hereto shall not affect the construction thereof.

27 GENERAL

27.1 Contractors must ensure that the condition laid down for submission of offers detailed in the preceding paragraphs, are completely and correctly fulfilled.

27.2 Tenders which are not complete in all details as stipulated above may be summarily rejected.

28 SECRECY

28.1 The Contractor shall take all reasonable steps necessary to ensure that all persons employed in any work in connection with the contract, have full knowledge of the Official Secrets Act and any regulations framed there under.

28.2 Any information obtained in the course of the execution of the contract by the contractor, his servants or agents or any person so employed, as to any matter whatsoever, which would or might be directly or indirectly, of use to any enemy of India, must be treated as secret and shall not any time be communicated to any person.

28.3 Any breach of the aforesaid conditions shall entitle the Purchaser to cancel the contract and to purchase or authorize the purchase of the stores at the risk and cost of the contractor in accordance with the clause–21 of the General Conditions of Contract. In the event of such cancellation, the stores or parts manufactured in the execution of the contract shall be taken by the Purchaser at such price as he considers fair and reasonable and the decision of the Purchaser to such price shall be final and binding on the contractor.

ANNEXURE 1 /GCC

Electronics Division, Bangalore

PROFORMA OF PERFORMANCE BANK GUARANTEE
(FOR FOREIGN PURCHASE ORDERS)

BANK NAME AND ADDRESS

Electronic Division
Bharat Heavy Electricals Limited, (B.H.E.L.)
Mysore Road, P.B. No. 2606
BANGALORE - 560 026

Dear Sir,

Ref : CONTRACT PERFORMANCE GUARANTEE.

WHEREAS you have entered into a contract reference No & PO NO._____ Date_____ with M/s _____ having its registered office at _____ for the supply of _____ as detailed in your purchase order No. _____ which is hereinafter referred to as "the said contract" and WHEREAS M/s _____ has undertaken to produce a Bank Guarantee for 10% (Tern Percent) of the contract price amounting to _____ (_____) to secure its obligatios to Electronics Division, BHEL having its registered office at New Delhi for the performance of the contract including the warranty of the equipment supplied, We_____ Bank, _____ hereby expressly, irrevocably and unreservedly undertake and guarantee as principal obligors on behalf of M/s_____ that in the even Bharat Heavy Electricals Ltd. (B.H.E.L.) declares to us in writing that M/s_____ has not fulfilled any obligation according to the contractual obligation of the said contract, to pay you on demand and without demur to Bharat Heavy Electricals Ltd., Electronics Division, Mysore Road, P.B.No. 2606, Bangalore - 560 026., India an amount of _____ (in words _____) subject to as may be determined below :

PROFORMA OF PERFORMANCE BANK GUARANTEE

1) Notwithstanding any right M/s. _____ may have directly against you or any disputes raised by M/s _____ _____ _____, Your written demand shall be conclusive evidence to us that repayment is due under the terms of the said contract and shall be binding on us.

2) We shall not be discharged or released from this undertaking and Guarantee by any arrangements, variations made between you and M/s. _____ with or without our consent and Knowledge or by any alteration in the obligations of M/s. _____ by any forbearance whether as to payment, time, performance or otherwise.

3) This guarantee shall remain valid until the end of twenty-four weeks after the close of the warranty period or until the same is reported by BHEL to us whichever is earlier.

4) We agree and undertake not to revoke this guarantee during its validity unless discharged in writing by you subject to the provision of clause (7) below :

5) This guarantee shall be a continuing guarantee subject to the foregoing and shall not be discharged by any change in the constitution of the Bank or M/s. _____.

6) This guarantee shall be governed by and constructed in accordance with the Laws of India.

7) At any time _____ Bank may rdner this guarantee null and void by paying to Bharat Heavy Electricals Ltd. the full amount being _____ (in words _____ _____)

For and on behalf of Bank
by its Authorised Signatory

ANNEXURE 2 /GCC

BHEL MEMBER BANKS (LIST OF CONSORTIUM BANKS)

PBG SHALL BE ISSUED FROM THE FOLLOWING 16 BANKS ONLY:

State Bank of India, CAG Branch, 10th Floor, Vijaya Building, Barakamba Road, NEW DELHI-110 001.	**Deutsche Bank,** Tolstoy Marg, NEW DELHI-110 001
Canara Bank, 74, Janapath, NEW DELHI-110 001.	**HDFC Bank Ltd.,** 5th Floor, H T House, K G Marg, NEW DELHI-110 001.
Punjab National Bank, 74, Janpath, NEW DELHI-110 001	**CITI Bank NA,** Jeevan Vihar Building, Sansad Marg, NEW DELHI-110 001.
Bank of Baroda, Corporate Banking Branch, 11th Floor, BOB Building, Sansad Marg, NEW DELHI-110 001	**Standard Chartered Bank,** H2, Block, Connaught Place, NEW DELHI-110 001.
State Bank of Hyderabad, Surya Kiran Building, K G Marg, NEW DELHI-110 001	**ICICI Bank Ltd.,** ICICI Tower, Bisham Pitamah Marg, Pragati Vihar, NEW DELHI-110 003.
HSBC Ltd., ECE House, 28 KG Marg, NEW DELHI-110 001.	**IDBI Bank Ltd.,** 19, K G Marg, Surya Kiran Building, NEW DELHI-110 001.
State Bank of Travancore, Travancore House, IF Branch, NEW DELHI-110 001.	**Corporation Bank**
ABN Amro Bank. N.V	**Syndicate Bank**

TENDER FOR ACQUISITION OF IGBT BASED TRACTION CONVERTER AND 3 x 130 KVA AUXILIARY CONVERTER USED IN WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES OF INDIAN RAILWAYS ALONG - WITH TRANSFER OF TECHNOLOGY

GLOBAL TENDER NO. NKKM900005

SECTION IV

TECHNICAL SPECIFICATION

SPECIFICATION FOR

IGBT BASED TRACTION CONVERTER

AND

3X130KVA AUXILIARY CONVERTER

TO BE USED FOR

6000 HP THREE PHASE LOCOMOTIVES OF TYPE WAG 9, WAP 5 and WAP 7

MANUFACTURED

BY

INDIAN RAILWAYS

TABLE OF CONTENTS

CHAPTER – 1: GENERAL

1.00 Introduction

1.01 M/S Bharat Heavy Electricals Limited (BHEL) is one of the leading Navratna Public Sector Undertaking of Government of India. The company has an annual turnover of US $ 4.50 Billion and outstanding order book of US $ 20 billion. The company has presence and interest in Power, Transmission, Defense, Transportation & Industry etc. In the Transportation field, BHEL's product range covers AC electric locomotives, AC-DC dual voltage electric locomotives, Diesel Electric Shunting Locomotives, Traction motors & transformers, traction electrics (3 phase AC & DC drives) and controls for AC, DC and dual voltage EMUs, diesel electric multiple units, diesel power car diesel electric locomotives, track machines and solutions for Urban Transportation Systems, including Electric Trolley Buses, LRT & MRTs. 70% of the trains operated by Indian Railways are equipped with traction equipment and controls manufactured & supplied by BHEL.

1.02 Indian Railways (IR) is currently manufacturing electric locomotives employing 3-phase propulsion based on the GTO Thyristor technology. Considering the issue of obsolescence of GTO Thyristor and the inherent technological benefits of Insulated Gate Bipolar Transistor (IGBT) and to upgrade the existing technology to the present state-of-the-art, Indian Railways plans to introduce IGBT based 3-phase traction converter and 3 X 130 KVA Auxiliary Converter on its 3-phase locomotives WAG9, WAP5 and WAP7.

1.03 **Demand Projections**

Indian Railways are at present manufacturing WAG9 & WAP7 locomotives with GTO based traction propulsion system. The GTO based propulsion system will be phased out to be replaced by IGBT based propulsion system. The phasing out is expected to be completed by end 2012. The business plan of Indian Railways in the XIth Plan for 3 phase IGBT locomotives is as under:

- Complete switch over to the manufacturing of 6000 HP ABB technology locomotive discontinuing manufacturing of low horse power conventional locomotives.
- Change over to IGBT control system instead of GTO on ABB locomotive
- Enhancing production capacity at CLW from 150 locos to 200 locos per year.

Following successful trials with IGBT based traction converter and 3 X 130 KVA Auxiliary Converter being procured against this tender; all future manufacture of locomotives by CLW is expected with use of IGBT based equipments.

1.04 This specification is intended to define the technical requirements of IGBT based traction converter and 3 X 130 KVA Auxiliary Converter as a functional replacement of the existing GTO based traction converter and 3 X 100 KVA auxiliary converters, retaining the other existing parts as much as possible. Necessary adaptations, wherever required, come under the scope of this tender. The IGBT version shall be compatible to existing vehicle control unit (VCU) based on MICAS-2 and suitable for retro fitment on existing 3 phase locomotives.

1.05 The existing three phase Traction Motors 6FXA 7059 and 6FRA 6068 and the existing Transformers LOT 6500 and LOT 7500 shall be retained. (Data Sheets for the motors and transformer enclosed). Two series resonant chokes available in the existing transformer also are to be used. The leading characteristics of IR's 3-phase locomotives, their Transformers and Traction Motors are given in Annexure 1, 2 & 3. Use of the existing choke has to be mandatory since transformer is to be retained.

1.06 Auxiliary converters (Aux Conv.) are used to supply three-phase auxiliary load (auxiliary motors) and battery charger. The Auxiliary Converter units are mounted in the machine room and are forced cooled. The Aux Converter electronics will be mounted in the converter cubicles and will have the necessary interface with the vehicle control electronics. The auxiliary converter with the vehicle control electronics should be designed on a bus system conforming to published open standard. The auxiliary converters shall be supplied in two preassembled units.

For clarity the Machine Room Layout is enclosed in Annexure -6 giving the details of the auxiliary converter position.

1.07 Our customer, Indian Railways intends to go for open control system for vehicle control and would like to integrate, in future. The design of traction converter and 3 X 130 KVA auxiliary converters should keep this aspect in view, though it is not covered in the present scope of supply.

1.08 The bidder is expected to study in detail the existing interface of the GTO Converter with the remaining equipment on the locomotive (e.g., Traction motor, it's speed and temperature sensors, Transformer with its Series Resonant Choke, Harmonic Filter, Cooling arrangement, Vehicle Control Unit etc.). The contractor is also expected to study in detail the existing machine room layout, ducting, cable routing etc. on the locomotive. Site visit for this purpose can be arranged on prior intimation to CLW. It will be deemed that the bidder knows all the relevant aspects at the time of making offer.

1.1 ABBREVIATIONS:

IR - Indian Railways
RDSO - Research Designs & Standards Organisation
CLW - Chittaranjan Locomotive Works
Bidder - Firm/companies participating in the tender
Contractor - The successful bidder for supply of the equipment
VCU - Vehicle Control Unit
GTO - Gate Turn off Thyristor
IGBT - Insulated Gate Bipolar Transistor
BoM - Bill of Material
VCB - Vacuum circuit Breaker
TM - Traction Motor
CON - Converter
Aux - Auxiliaries
FLG - Fahrzeulelt gert (German) – (VCU – Vehicle Control Unit)
SLG - Engine Control Unit
DCU - Drive Control Unit
TE/BE - Tractive effort/Braking effort
S&T - Signal and Telecommunication

1.2 STANDARDS

This Particular Specification is based on the following Normative References. Only those revisions will be taken, which are valid on the date of signing the contract.

Standards	Title
IEC 60077-1	Railway applications – Rolling Stock General Rules
IEC 61287-1	Railway applications – Power converters installed on rolling stock
IEC 60571	Specific rules concerning the electronic control part of converters.
IEC 61373	Railway applications – Rolling stock equipment – shock and vibration test
IEC 60310	Traction transformers and inductors on board rolling stock
EN 50121-3-2 (CENELEC)	Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock - Apparatus
EN 50121-2 (CENELEC)	Railway applications – Electromagnetic compatibility Part 2: Emission of the whole railway system to the outside world.

IEC –61375-1	Electric Railway Equipment-Train Bus Part –1: Train communication network.
EN 50153	Railway applications – Rolling stock – Protective actions against electrical hazards
EN 60529	Protection classes of cases (IP-Code)

1.3 Documentation

Following documents shall be submitted by each bidder along with the offer for evaluation:

Traction Converter

- Schematic Circuit
- Functional Description
- System design concept
- Communication protocol and software structure description along with compatibility with the present locomotive control system.
- Cooling design
- Mechanical interface diagram and compliance to existing mechanics
- Calculation and simulation results of system behaviour, including interference to the S&T circuits.
- Full descriptions of the modifications needed in the present locomotive for accommodating the offered system
- Salient features and advantages of the offered system
- Details of technical support and training offered.
- List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair along with full technical specifications and probable suppliers.
- Guaranteed values of efficiency of devices/subassemblies and assemblies
- Calculation to withstand short circuit current under fault conditions
- Confirmation whether existing filter arrangement is adequate to take care of interference or not.
- Details of short time rating of the converter.
- Expected efficiency with respect to vehicle load/speed along with calculations
- Details/proof of proveness of the devices proposed to be used.

3 X 130 KVA Auxiliary Converters

- Detailed specification of the offered converter, major equipments like transformer, chokes, and DC link capacitors as well as MCCBs & fuses.
- Design calculations including the calculation of safety margin in voltage, current, thermal (for junction temperature) along with the limit value of power devices. Detailed calculation of cooling system design and its efficiency are to be furnished. Minimum airflow rate, which will give the desired cooling, should be mentioned.
- Mechanical drawings of complete cubicles as well as Major subassemblies / rack with details of dimensions, mounting arrangement and weight, which are required to be taken out for maintenance. Details of mounting accessories should also be provided.
- Details of protection provided and their effectiveness / proposed set values and range and working principle. Details of implementation i.e. through software and hardware should be clearly spelt.
- System description, power circuit diagram along with bill of material of major equipments, circuit description, working principle and salient features. The details of microprocessor / microcontroller used, functional block description of PCBs used, control system hierarchy, protocol used and interfacing.
- Detail operation of panel and function of each switch, indications and fault diagnostic feature.
- Declared output voltage and current waveform, THD and regulation.

General Documentation for Traction Converter & Auxiliary Converter

- Clause by clause compliance
- Credentials with details of supply made of such items.
- Data sheets for devices and other equipment proposed along with detailed description of supply proposed
- Logistics proposed for warranty support within India.
- Declaration for long-term support by the bidder and technology transfer declaration.
- Recommended list of spares with cost for 3-year maintenance after warranty along with full drawing/design and details of OEM.
- QAM (Quality assurance manual).
- Test protocol with procedure of testing.(Type and Routine)
- Data sheet of major components duly filled.
- ISO 9000 certification

1.31 The successful bidder shall submit the design details, including but not limited to the following, to BHEL before commencing manufacturing. Only on getting the approval from BHEL/RDSO in writing should the production begin.

- Technical documentation explaining the complete scheme, characteristics, diagnostics, protection and control etc.
- Detailed drawings of each system/sub-system with interface details.
- Design calculations for selection of devices, cooling systems and various subsystems, establishing the adequacy of the components selected.
- Complete material / technical specification of components with source of supply.
- Cooling system design description, data and cooling fluid data
- Mechanical drawings, mounting arrangement, weight, details of mounting accessories
- Bill of Material along with their sources
- Procedure for parameter alteration, software downloading, diagnostic uploading, analysis etc.
- Schedule maintenance activities with periodicity.
- Maintenance, Trouble shooting and repair manual in soft form & hard copy.
- Spare parts catalogue with details of suppliers for trouble free maintenance for three years.
- All calculations evaluated on the basis of software simulations shall be supported by sample calculations.
- Approval of design means approval of general design features. Notwithstanding the approval, the contractor will wholly and completely be responsible for the performance of the complete equipment.
- For the purpose of technical decisions on improvement / modifications etc. on the equipment, BHEL/RDSO shall be the final authority from purchaser's side.
- Details of Tools and Plants with design/drawings and supplies.

1.4 Infringement of Patent Rights

BHEL/Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing of inverter and any other factor, which may be cause of such dispute. The responsibility to settle any issue lies with the manufacturer.

1.5 Scope & Object

This specification covers the technical aspect of two numbers of IGBT traction converters and one number 3 X 130 KVA IGBT based auxiliary converters housed in two cubicles for the new three phase locomotives of the type WAG9, WAP5 & WAP 7. Refer machine room layout for the position of the equipment (Annexure 6). It explains the interface requirement of the equipment with the locomotive and traction system clarifies the load pattern on the static converters and lays down the desired performance and testing methodology. Relevant IECs will be the governing specification except for what is mentioned in this specification.

1.6 Bidders Responsibility

Bidder responsibility will be extended to the following

1.6.1 The bidder shall supply detailed instructions for proper installation of the equipment on the locomotive. For this purpose the bidder should also depute his representative during installation of the first two equipments in the locomotive at each location Electric Loco Shed of Indian Railways(IR) and manufacturing plant M/s Chittaranjan Locomotive Works (CLW), Chittaranjan.

1.6.2 The bidder shall be responsible for commissioning, testing & field trials of the prototype equipment in service and depute team of engineers for this purpose. The bidder shall arrange to carry out detailed test & field trial jointly with BHEL/CLW.

1.6.3 The bidder shall also quote for special tools, testing jigs, laptop preloaded with MS-Windows and application software and instruments, which may be required for troubleshooting and maintenance of the static converter separately.

1.6.4 The bidder shall quote for spares, which may be required for satisfactory maintenance of the equipments for a period of 5 years.

1.6.5 The bidder shall also submit on demand repair charges for the cards. The repaired card will have warranty of one year. A separate contract will be executed with the contractor for the repairs.

1.6.6 The bidder shall supply suitable software “if applicable” for off-line analysis data downloaded from the static converter.

1.6.7 The design shall be developed as per requirement given in the specification. The detailed design shall be submitted to BHEL/RDSO/CLW for scrutiny and approval before commencing of the manufacturing. Here “approval” means the “approval of design features” only. The bidders shall be responsible for performance of complete Traction Converter and 3 X 130 KVA Auxiliary Converter.

1.6.8 The bidder shall be responsible for carrying out all the modifications at his own cost on any part of the equipment supplied during the period of warranty required for satisfactory operation of the equipment as per technical specification.

1.6.9 The bidder shall supply the write up and the elaborate manual for maintenance and trouble shooting in soft copy free of cost to BHEL.

1.7 Exclusions

i) Traction Converter

a) The cabling between traction converter, transformer and traction motor.
b) The control cabling if any between power converter and VCU.
c) The cabling between any transducers and control electronics of traction converter
d) The cable for connecting volt free contacts to vehicle control electronics (VCE).

ii) Auxiliary Converter

a) The cabling between auxiliary converters, transformer and designated auxiliary loads.
b) The control cabling if any between auxiliary converter and VCU.
c) The cabling between any transducers and control electronics of auxiliary converter
d) The isolation and switching arrangement for auxiliary motors.
e) The cable for connecting volt free contacts from auxiliary converter to vehicle control electronics (VCE).

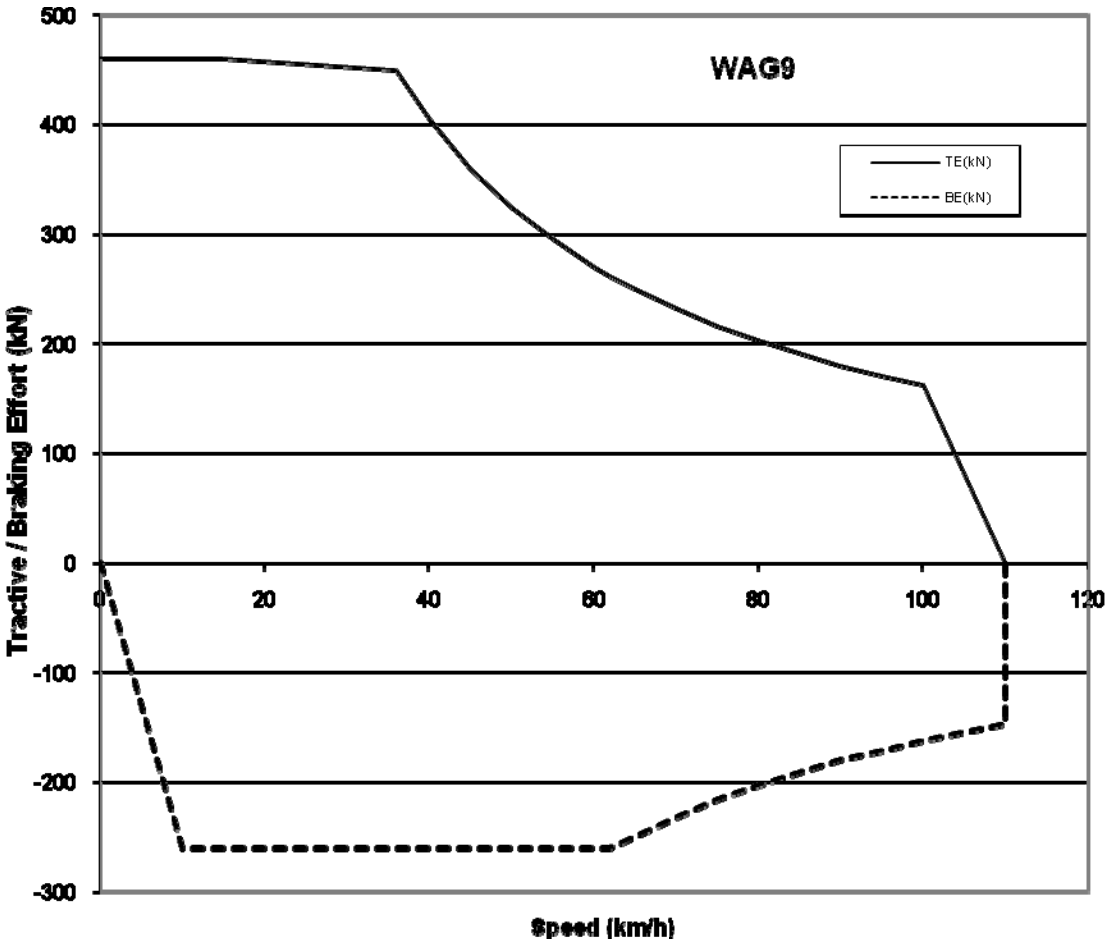
Note:

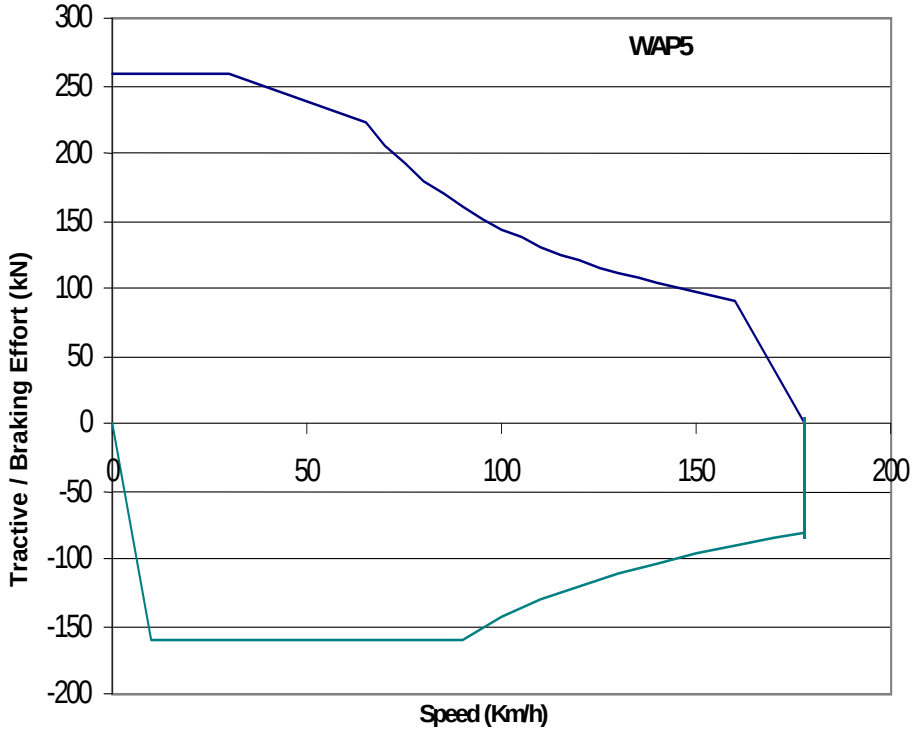
Provisions of space to be made to accommodate hotel load converter in the traction converter. This must be confirmed by bidders in their offer clearly.

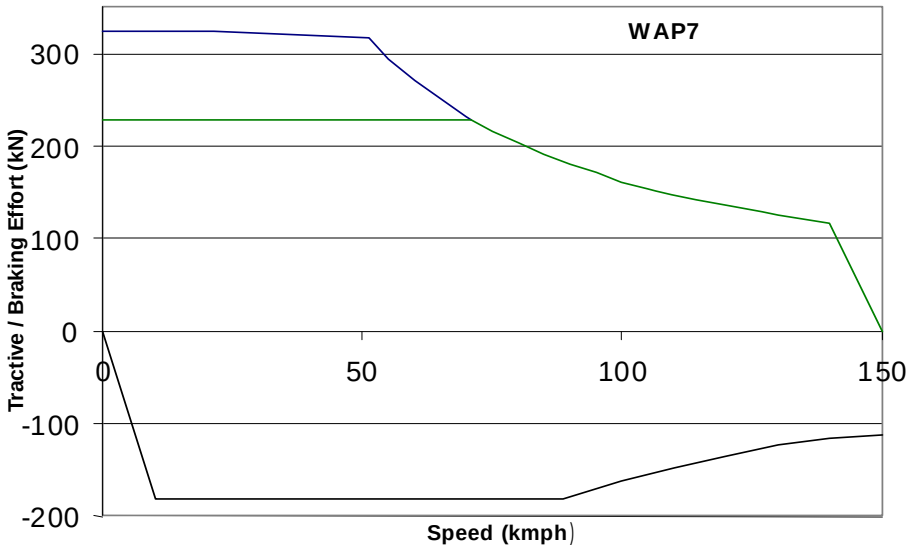
CHAPTER 2- TECHNICAL SPECIFICATION OF TRACTION CONVERTER

2.1 Performance Parameters

2.1.1 The present characteristics of WAG9, WAP7 and WAP5 locomotives with GTO based propulsion are as given below:







2.1.2 With adoption of IGBT based traction converter, using the same traction motors and gears & pinions, the Tractive Effort / Braking Effort curves of WAG9, WAP7 and WAP5 locomotives should match the existing curves. In addition, the IGBT Traction Converter should have capability to generate 510 kN starting tractive effort on WAG 9H locomotive having axle load of 22.0 t.

2.1.3 Duty Cycle:

WAG 9 Locomotive working in adverse terrain has to negotiate longer periods at lower speeds. The typical duty cycle encountered in operation could be as given below and loco propulsion system and equipment should be able to work satisfactorily under such conditions.

Speed	% of total running time of loco	TE Desired
0-10 km/h	5	510 kN
10-30 km/h	10	450 kN
30-60 km/h	20	350 kN
60-80 km/h	50	230 kN
80-100 km/h	15	180 kN

The drive control electronics shall have an installed protection against sustained overloads of the converter and connected drive system so as to prevent damage.

2.1.4 Adhesion requirements:

The design of the adhesion control will be optimised for maximum utilisation of adhesion factor and should be such that it is capable of generating the required starting tractive effort on WAG9, WAG 9H, WAP7 and WAP5 locomotives under dry rail conditions. The bidder will state the value of maximum starting tractive effort that will be developed under dry rail conditions and also under all weather conditions, which will be demonstrated during testing. The adhesion control system will be capable of giving high adhesion through a wheel slip control system of proven performance. The objective should be to maximise the delivered draw bar pull through control system in conjunction with sanding. The achievable running adhesion characteristics will be made available. The formulae for linking adhesion characteristics with the operating speed will be indicated.

2.2 Overhead Traction Supply

2.2.1 The overhead voltage is 25 kV_{ac}, 50Hz, single phase. The supply voltage is fed to the traction transformer through a Vacuum Circuit Breaker (VCB). The transformer output is to be connected to the traction converter. The overhead traction supply is subjected to variations as under:

Nominal Voltage	-	25 kV_{ac}
Maximum Voltage	-	27.5 kV_{ac}
Minimum Voltage	-	19 kV_{ac}
Occasional Maximum	-	30 kV_{ac}
Instantaneous Minimum	-	17.5 kV_{ac}
Supply Frequency	-	50 Hz $\pm$ 8%

The occasional maximum and instantaneous minimum voltage may persist for 30 min.

2.2.2 The performance of the converter will be guaranteed between 19 kV_{ac} and 27.5 $kV_{ac.}$ The design calculation will establish the same. Variation of Power over 27.5 kV_{ac} and below 19.0 kV_{ac} shall be submitted. However, design calculations will be based on OHE voltage of 22.5 kV_{ac}.

2.2 The transformer output voltage will vary in accordance with the overhead supply. The details of the transformer and VCB used are given in Annexure-2 and Annexure-4 respectively. The propulsion system offered shall be designed to withstand the voltage variations mentioned above

.

2.3 Technical requirements

The system and equipments will be of proven latest technology specially adopted for application to meet the performance requirements under environmental conditions specified in this Chapter 3. Adequate margin will be built in the design, particularly to take care of condition of high ambient temperatures, dusty condition, high humidity prevailing in India.

(i) The converter will be designed and operated to achieve near unity power factor and minimum harmonic interference current. The input power factor shall be settable close to unity within the line voltage range from 19 kV_{ac} to 27.5 kV_{ac} at all speeds of operation of the locomotive. The maximum interference current permitted is specified in Para 2.5 of this specification.

(ii) In design and construction, reliability and maintainability will be of paramount consideration. Bidder will submit reliability calculations indicating MTBF for different devices, cards and sub-assemblies. Adequate margin will be provided to take into account ambient conditions prevailing in India.

(iii) High efficiency of equipment will be important consideration, next only to high reliability. The components and technology used shall ensure very high efficiency of the converter. Bidder shall furnish the expected efficiency with respect to vehicle load/speed with necessary calculations.

(iv) Modular constructions will be adopted wherever considered possible. Easy access for inspection / maintenance and minimum maintenance requirement will be given special consideration in design and layout. In this reference, the scheduled maintenance activities shall be a part of design documents and have to be got approved along with design approval.

(v) Semi conductor devices rating will be selected so as to provide margin of 25% vis-à-vis design/calculated current and voltage values under worst operating conditions after taking into account voltage jumps and current surges on account of inductance and capacitance in the circuit.

(vi) The design calculations of worst case temperature rise of equipment shall be made after taking into account 25% choking of filters and radiator fins. A safety margin of at least 10ºC shall be kept with respect to maximum permissible junction temperature of power devices declared by the manufacturer.

(vii) The converter/inverter system will be capable of withstanding the maximum short circuit current under fault conditions and these will be established through calculations. The converter / inverter system shall also be designed to withstand extreme disturbances like short-circuit / open circuit etc. at all points of input / output interfaces with locomotive, without any failure.

(viii) The electronics of the Converter shall be designed to be sealed from the remaining part of the Converter so as to ensure that there is no dust ingress whatsoever in to the electronics. For its cooling, internal ventilation arrangement along with heat exchanger for removal of heat shall be provided. Temperature difference between inside of the electronics cubicle and the Machine room shall not be more than 5ºC.

(ix) All equipment shall be adequately earthed, insulated, screened or enclosed. They should be provided with essential interlocks and keys as may be adequate to ensure the protection of the equipment and safety of those concerned with its operation and maintenance.

(x) The electronic card shall be mechanically coded to ensure that insertion of card in wrong slot is not possible.

(xi) Following special features will be provided to maximise the performance and minimise possibilities of trains being stalled on the section

(a) Individual and independent inverter to be provided for each TM / axle so that one TM / axle can be isolated in the event of fault and train worked with remaining TMs. The adhesion control system will also be optimised for the individual axle drive. Wheel diameter difference permissible on different axles will also be liberal.

(b) Suitable redundancy to be provided in the vital PCBs connected with safety and power supplies, so that locomotive failure and disabling the train is avoided in the event of their failure.

(xii) The electronic rack shall be housed within a sealed casing. The internal airflow will be provided by internal fans. The air from the machine room shall indirectly cool the casing.

(xiii) All the proposed equipments shall not violate the given space envelopes of the equipment to be replaced. Any needed change due to new equipment has to be demonstrated with the help of suitable drawings.

Item	Proposed Dimension (l x w x h) mm
IGBT Converter with VCU interface	3000 x 1100 x 2100
Cooling tower with water/air and oil/air exchanger	1450 x 1154 x 1510
Machine Room Blower	800x 1100 x 1620

(xiv) Existing principle of the machine room ventilation shall be kept unchanged as far as possible. Any need for changes shall be brought out in the bid.

(xv) Motor and gear shall be retained. Bidder has to provide IR with all necessary manufacturing drawings for necessary adaptations.

(xvi) Bidder shall endeavour to supply lubricants available in India.

2.4 Converter Output

The motor converter output current ripple should be such as to keep the torque pulsations and traction motor heating to a minimum. It is the bidder responsibility to make sure that output quality of the Traction Converter is entirely suitable for the existing traction motors. The motor converter shall generate the 3-phase output with higher pulsating frequencies and improved pulse pattern than with the existing GTO system.

2.5 Interferences

(i) The electric and electronic apparatus used in propulsion system will comply emission and immunity aspects of EMC to CENELEC standard EN - 50121-3-2. The internal EMC shall cover a combination of earthing, shielding and isolation of interference sources so that conducted and radiated noises are properly segregated or suppressed and no other equipment is affected due to operation of converter.

(ii) The harmonic currents injected in the overhead supply system (as also the track return current) can introduce voltage harmonics on power supply and can interfere with signal and telecom circuits. The following interference current in the input current shall not be exceeded at any point in the operating envelope of the locomotive:

Psophometric current	10.0 A
DC component	4.7 A
2nd Harmonic component	8.5 A
1700 ± 50 Hz component	400 mA
2000 ± 50 Hz component	400 mA
2300 ± 50 Hz component	400 mA
2600 ± 50 Hz component	400 mA
5100 ± 50 Hz component	270 mA

Emission from locomotives to outside world will be limited to level specified under CENELEC standard 50121 –2. The bidder shall submit the simulated values of these interference currents in their offer.

The existing transformer, which is to be used, is provided with a filter winding as given in the schematic diagram (Annexure-8). The resistance and inductance values of the windings have been given in the Annexure - 2. The filter resistor and filter capacitor ratings are 2800 V, 0.2 ohm/40 KW & 0.2 ohm/60KW and 0.4 mF, 2500V, 80A(bank capacity) respectively. During single bogie operation, filter adaptation contactor is opened thereby introducing an additional resistor. During normal operation, contactor remains closed. The existing harmonic filter has to be considered while designing the system for interference limits. It is expected that with higher switching frequency of IGBT, this should be sufficient to meet the stipulated harmonics requirements. It may even be possible to simplify the Harmonic Filter. The bidder shall indicate clearly the filter arrangement required, and if any modifications are required, it has to be done through choosing appropriate external RC elements, which shall then be provided to BHEL/Indian Railway for necessary modification in the locomotive.

2.6 Mechanical Dimensions

Dimensions of the existing Traction Converter are 3000 X 1100 X 2100 mm. The dimensions of the IGBT traction converter should not exceed these values. Detailed dimensional drawings can be made available to the bidder at CLW.

2.7 Cooling

The Present GTO Converter uses forced oil cooling. There is a common aluminium alloy heat exchanger module for both converter and transformer, but with different oil circuits. The blower is common. There are two cooling units, one for each bogie.

The bidder can either use the existing radiator and cooling circuit with blower and pumps for the cooling of the Traction Converter or suggest his own radiator within the existing floor layout available. The sealing of the cooling system should be such as to prevent spillage / leakage of the coolant. In case the coolant used for the converter is other than oil, for example water, the new radiator shall be accommodated at the present location utilising the same blower. Any alternative arrangement has to be clearly spelt out. The existing cooling details are enclosed (Annexure-11 & Annexure - 13).

2.8 Interfaces between converter and control equipment

2.8.1 The Traction converter has to work with the existing Vehicle Control Unit, which is based on MICAS S2 control & communication (C&C) system of M/s Bombardier Transportation. The bidder shall give a suitable interface to the existing VCU. All the control and communication functionalities of the existing Traction Converter shall be met by the proposed IGBT based propulsion system. Modified software suitable for the converter shall be within the scope of this specification.

2.8.2 The proposed traction converter shall be compatible to TCN standard as per IEC-61375.

2.8.3 Presently the complete vehicle level software source code and programming tools used are with CLW/IR. The proposed changes in VCU shall not dilute CLW/IR's control over the vehicle level software & tools in terms of their ability to carry out changes on their own, or should not impact the existing preparedness in terms of rendering acquired skills & tools un-usable. Thus changes if any, made shall be done in association with CLW and validated by RDSO following present practice of CLW/IR. However, the primary responsibility of the software changes & integration shall be on the bidder/BHEL. The MICAS-S2 C&C is administered over MPB card based diagnostic system. Changes in VCU shall not necessitate a separate tool for VCU. The converter may have a tool of its own for its diagnostic & troubleshooting. Existing versions of tools used are as under:

Sl.No	Tool	Version
1	MIC Project	3.8
2	MIC View	4.6.1
3	MIC Download	4.5.4
4	MIC Info	7.1.3
5	MIC Bus	3.5

CHAPTER 3 - SCOPE OF SUPPLY FOR TRACTION CONVERTER

The following will be scope of work for the contractor.

#	Item Description	Qty/loco set
1	IGBT based traction converter with its control system.	2 nos.
2	Heat Exchanger(s)– if existing equipment cannot be adopted (Ref. Clause 2.7 of chapter-2	1 set
3	Design modification for harmonic filter resistor and capacitor (Ref. Clause 2.5 of chapter-2)	
4	Hardware and software Interface with vehicle control Unit.	1 set
5	Software update for the vehicle control	
6	Description of all design modifications to adopt all new and revised systems	
7	Laptop based software tool for downloading the software, viewing and changing the parameters, trouble shooting, in Traction Converter /Aux. Converter control system along with user licence.	1 set
8	Installation Drawings, Maintenance and repair manual (hard copy and soft copy both)	3 sets
9	Supplier's Documentation and Spare Parts Catalogue with details of suppliers, Consumable data (hard copy and soft copy both).	3 sets
10	Submission of design data / document for approval prior to manufacture	3 sets
11	Installation, testing and commissioning of the above equipment at CLW.	
12	Training on assembly, testing, commissioning, operation, maintenance and repair to IR personnel.	
13	Training in software parameter settings, fault diagnostic and analysis.	
14	Special tools and jigs for 3 years maintenance (the successful bidder shall give a list with quantities) with specifications and details of suppliers	1 set*
15	Spares for 3 years maintenance (the successful bidder shall give a list with quantities) with details of suppliers.	1 set*
16	Type test in one unit of all equipments.	
17	Routine test in balance units of all the equipments.	

* The contractor shall quote for these items separately. These items will not come under evaluations.

The bidder shall supply above items to BHEL/CLW and the fitment of these items will be done at CLW under the supervision of successful bidder. The special tools, machines, instruments and other facilities which are required for installation, commissioning of system that are not available in CLW, shall be supported by bidder.

CHAPTER 4 -TESTS & TRIALS FOR TRACTION CONVERTER

4.1 Prototype tests will be performed on one unit (manufactured as per approved design) to verify that product to meet the requirements specified and agreed upon between users & manufacturer. Series manufacture shall commence only after successful prototype tests.

4.2 Routine tests are to be carried out to verify that properties of the product corresponding to those measured during type tests. Routine test are to be carried out by the manufacturer on each equipment.

4.3 The converter shall be tested in accordance with IEC 61287, (Including all optional tests) & the control electronics shall be tested as per IEC 60571. (Including the following optional test –performance test (cl. 10.2.2), dry heat test (Cl. 10.2.4 to be done at 80 ° C), damp heat cyclic test (Cl 10.2.5), salt mist test (Cl. 10.2.10).

4.4 The bidder shall submit complete test programme for type and routine test to BHEL/RDSO as a part of design approval. Bidder will carry out the test as per mutually agreed test programme at his own cost.

4.5 The prototype units will be inspected & tested by the engineers of BHEL/RDSO and CLW at the factory premises or at mutually decided venue where all the facilities should be made available for carrying out the prototype test. The equipments will be kept in field trials for a period of six months. The RDSO engineers will associate and witness the tests in the locomotive also till they are successfully completed. Any defects noticed / design improvement found necessary as a result of the test / trial shall be carried out by the bidder in the least possible time. Serial production shall only start after successful trial run on loco and clearance to this effect given by BHEL/RDSO.

4.6 Type test will be repeated in following cases.

- Modification of equipment, which is likely to affect its function.
- Failure or variations established during type or routine test.
- Resumption of production after an interruption of more than two years.
- At the time of indigenization, if the firm has supplied the product with foreign collaboration originally.

4.7 Investigation tests are intended to obtain additional information regarding the performance of the product. They shall be specially requested either by the user.

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

4.9 INSTRUMENTATION

(a) All the instruments used for testing should be duly calibrated. The calibration certificates are to be shown to inspecting authority on demand.

(b) Value of the fundamental component and THD of inverter output will be measured by power analyzer during the prototype test at various mutually decided preset points in traction and braking modes. True value of output voltage is also to be measured for record.

(c) Input power factor and the efficiency will be measured using power analyzer at rated load.

4.10 Clarifications with respect to certain tests are given below

(a) Visual inspection –The object of visual inspection is to check that the equipment is free from defects and the equipments are as per approved drawing. Bill of materials will be submitted. The make, rating of equipments, subassemblies will be checked with the details as per approved design proposal submitted in design proposal. If a change is needed in make or rating of important equipments, sub-assemblies it should be intimated and should have approval of BHEL/RDSO. All the important dimensions will be measured and should be within permissible tolerance.

(b) Power loss determination test – This test will be done at voltage corresponding to 22 .5 kV in OHE. The efficiency will be measured at full and 80 % of load.

(c) Earth fault - Simulate the earth fault by connecting a suitable resistor between cubicle frame and output phases. The Power Converter should not trip and earth fault indication will be in “OFF” state till the leakage current is less than limit approved as part of design proposal submitted by the Bidder/Tenderer.

(d) Burn in test -- The cards used on the equipment will be subjected to burn- in as per the temperature cycle in Annexure-5. The cards will be kept energized during the test. Functional test of each card will be carried out after the burn in test. (Pl. refer Clause 10.2.13 of IEC 60571). This will be part of internal test by manufacturer, whose results will be submitted during routine test.

(e) Cooling test – The purpose of this test is to verify that the cooling of various components / assemblies. The parameters for measurement to check efficacy of cooling system will be decided based on scheme proposed as part of design proposal.

(f) Insulation resistance and Dielectric test -- The insulation resistance with 1000 V megger shall not be less than 100 M ohms at 70 % RH for all the circuits. The dielectric test shall be carried out after shorting semiconductor device, pulse transformer earthed, earthed special cards if necessary before applying Dielectric voltage. The level of dielectric voltage will be as per IEC 61287.

(g) Temperature rise test –Traction converter shall be loaded to full load for 6 hours with input OHE voltage of 19 kV and with 50% blockade of the inlet filters, if used. The temperature rise shall be recorded by temperature detectors mounted at the specified reference points on the body of semiconductors, capacitors, and other components as agreed between purchaser and manufacture. The maximum recorded temperature under worst condition shall be corrected for 55°C and compared with maximum permissible temperature. (for power devices at junction). The thermal margin available shall be compared with the safety margin declared by the manufacturer. The temperature of the power devices shall have a margin of minimum 10°C.

h) Damp heat test – Function test of each card will be carried out after the damp heat test.

4 .11 **Signalling and Interference tests**

Tests to determine the levels of interference with the traction power supply and Signal and Telecommunication equipments and facilities to prove that these are within acceptable limits. (Reference to chapter-2, clause 2.5)

CHAPTER – 5: TECHNICAL SPECIFICATION OF 3 X 130 KVA AUXILIARY CONVERTERS

5.1 The converter at AC input may use thyristors or IGBTs. The inverter should, however, be with IGBTs. The control should be microprocessor / micro-controller based with diagnostic facilities. The specification has been drawn for: Three static converters identical in all respects each with 130 kVA capacity and battery charging unit (details in 2.2) constitute one loco set of equipment, however, for sake of clarity unless otherwise specified following applies to each of the converters which may be referred as AUX_1, AUX_2 and AUX_3 respectively housed in two cubicles, cubicle-1 will have AUX_1 and cubicle-2 will have AUX_2 & AUX_3.

5.2 **Converter Ratings (AUX_1, AUX_2 & AUX_3)**

A. INPUT

(a) Voltage	:	1000 V single phase 50 Hz at a catenary voltage of 25 kV. The catenary voltage can vary from 19.0 kV to 30 kV and in abnormal conditions may dip down to 17.5kV, which may last for upto half an hour.
(b) Frequency	:	50 Hz ± 6%
(c) Power factor	:	0.8 or more (at full load) between OHE voltage 19 kV to 27.5 kV and min. 0.55 above 27.5 kV
(d) THD (Current)	:	< 10%
(e) Winding Details	:	334 kVA / 5.82% Impedance /268.58 mΩ

B. OUTPUT

(i) AC, 3 phase

(a) AC voltage (L-L)	:	415 V ± 5%
(b) Nominal Output Frequency	:	50 Hz ± 3%
(c) KVA output	:	130 KVA
(d) Short time current rating	:	450 Amp ± 10 % for 6 to 10 Sec
(e) THD in the output voltage to the 3-ph motor	:	< 10%
(f) dv / dt	:	Less than 500V/Microsecond

The auxiliary converter shall be suitable for generating 3-phase AC output at multiple voltages and frequencies as detailed in para 5.5 below

(ii) **DC output** **:** 111V, 80A with current ripple less than 5% and voltage regulation ± 5%, with battery current maximum of 110A

The Battery Charger characteristic should be suitable for charging the existing 199 AH Ni –Cd battery & supplying the 110 V load in 3-phase locomotives

C. Efficiency at rated output **:** Minimum 92% at rated load (130 KVA) of 0.8 pf

Note: Rated capacity of 130 kVA is expected for input voltage range of 19kV to 30kV. However, degraded performance in terms of lower output voltage or frequency is acceptable below 19kV and bidder will specify the extent of degraded performance. It will not be possible to regulate the duty cycle of the loads.

The existing smoothing choke which is rated at 155A (Max.190A) shall be explored for adoption in the improved design of Auxiliary Converter (3X130 KVA). In the event of inadequacy of the existing choke, the bidder shall offer alternative choke design, keeping in mind that this choke will be provided in the machine room and may lead to increase of machine room temperature. The details shall be furnished.

The details of the existing smoothing choke are as below.

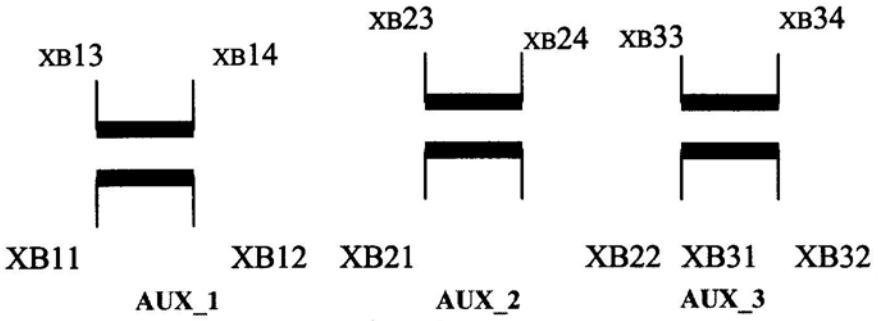
Quantity : 3 Nos. of decoupled single phase chokes
Location : Inside transformer tank

Inductance value of each auxiliary converter chokes at different currents:

0 A : 30 mH
120 A : 30 mH
155 A : 26 mH
190 A : 20 mH

Tolerance : - 0%, not specified
Frequency : 100 Hz
Current Nominal : 155 A
Max. : 190 A
Ripple : 38.6%
Max. : 50.2%
Losses at I_{nom} : 12 kW + 15% total

Terminal Notation



Each choke consists of a magnetic frame. The chokes are arranged in a stack. Since asymmetric voltages are applied across these, the chokes are decoupled.

The DC link elements are designed for a nominal power of 100 kVA.

5.3 Load pattern : The normal & emergency loadings are shown in Annexure-9, page 2 of 4 to page 4 of 4.

5.3.1 Three phase auxiliary load

Auxiliary loads on individual auxiliary converter in normal and fault conditions shall be distributed as detailed in Annexure-9.

Auxiliary converter should be in a position to soft start the loads using variable voltage variable frequency control.

5.3.2 **DC load:** The locomotive control circuit, loco head light, flasher light etc. are fed through 110V DC circuit containing locomotive battery.

5.3.3 Reconnection of the loads under emergency

If one of the auxiliary converters fails then the provision is made for continued operation with reconnection of loads. The reconnection of loads is done with the help of contactors with interlocking feature. See Annexure-9 for the proposed connection. These contactors are controlled by the vehicle control electronics. The necessary actions for reconnection will be taken by vehicle control electronics.

5.4 Protection

5.4.1 The devices used in the inverter shall be protected against high rate of rise of voltage & current, line transient surge, switching surges etc. The converters shall be protected against:

(a) Open circuit in auxiliary winding

(c) Ground fault in 3-phase load

(d) Auxiliary converter phase fault

(e) Line to line short circuit due to dead short at motor terminals

(f) Thermal over loading

(g) Fuse failure in converter

(h) High / low voltage in DC link

(i) Failures of power supply to control electronics

(k) DC link short circuit

(l) Input over voltage / under voltage

(m) Input over current

The details of such protection shall be submitted by the successful bidder for review during design stage.

5.4.2 The equipment shall be protected against internal transient, spikes and surges as per limit laid down as per IEC 60571 (1998-02).

5.5 Multiple voltage / frequency operation

The energy conservation feature through multi level ventilation/ cooling, as existing in the present 3X100 kVA GTO based Auxiliary converter shall be retained. At present, frequency steps for multiple operations are 24Hz, 37Hz, 47Hz and 50Hz.Steps of voltage /frequency to be adopted for multiple frequency operation as well as methodology of implementation shall be finalize at the design approval stage.

5.6 Integration with Vehicle Control Electronics

Control and communication of Auxiliary converter with vehicle Control Electronics (VCU) shall be through hardwired connection through spare 110V DC digital input/output potential free contacts.

The operational control and status shall be communicated through digital input/output lines. These will include but not be limited to commands and feedback signals for ON/OFF, frequency/voltage steps and failure/healthy status. Details should be finalized at the design approval stage. These signals will be suitably integrated with vehicle control electronics for which necessary software changes will be made by IR.

Cabling between auxiliary converter and VCE will be provided by IR.The design shall be developed in such a way that in case of digital frequency control signal not being available, the auxiliary converter shall works as standalone system with 50 Hz 3-Ø AC output.

IR intends to go for open control system for vehicle control and would like to integrate, in future. The auxiliary converter with the vehicle control electronics on a bus system conforming to published open standard. The design of auxiliary converter should keep this aspect in view, though it is not covered in the present scope of supply.

5.7 Fault Indication, Diagnostics and Trouble Shooting

A suitable fault diagnostics and trouble-shooting arrangement as per functional requirement of 3-phase locomotive shall be provided locally on the auxiliary converter. The faults shall be down loadable on a laptop computer through a standard port /interface. Large capacity of storage of faults along with the background data should be provided, so that data pertaining to at least 90 days are kept stored. Details of the fault diagnostics and indication of faults / health status shall be finalized during the design approval stage.

5.8 Safety

Following shall be provided in each Auxiliary converter cubicle for human safety.

a) Indication of presence of high voltage (Voltage Indicator)
b) Safety interlocks on front panel with lock and key to be integrated with existing key multiplier system.

5.9 Mechanical dimensions (Refer drawing – Annexure-10)

The spaces for retrofitment of static converter in place of existing equipment are mentioned under. It is to be ensured that the above equipment could be fitted in existing types of locos of IR namely WAP5, WAG9.

Envelope size of the space available in the locomotive for mounting the equipment (all dimensions are in mm) for retrofitment on WAP5 / WAG9 locos will be as under:

		Overall Size	**Mounting Dimensions**
(i)	Cubicle 1	1160 ×1020×1860 (L×D×H)	1120×900 (L×W)
(ii)	Cubicle 2	1520 ×1020×1860 (L×D×H)	1480 ×900 (L×W)

Note:

A. A gap of 50 to 100mm only is available between roof and equipment in the locomotive and hence cooling system design should be done accordingly.
B. Each cubicle houses fully identical 130 kVA converter as described in 2.1.
C. Offer should include power loss calculation considering existing cooling system.

5.10 The weight of the current Auxiliary converter cubicles are approximately 608 Kg for cubicle –1 (Aux_1) and 1130 Kg for cubicle-2 (Aux_2 & Aux_3)

5.11 Enclosure:

5.11.1 The current enclosure is shown as part outline drawing (Annexure-10).

5.11.2 Any alternative design meeting functional requirement can be offered with full details for BHEL/IR`s scrutiny and approval.

5.11.3 The enclosure for electronics shall be free from dust and moisture. Design of cooling heat exchanger shall be done to ensure temperature difference less than 10 degree centigrade across the heat exchanger.

5.12 Cooling (Annexure-11)

From machine room blowers, a part of the cooling air is guided to the existing auxiliary converter cooling. The heat losses in the auxiliary converter are carried away through the heat exchanger. The ventilation air guiding ducts from the machine room to cubicle 1 & 2 provide following air values: **Bidder to explain the cooling methodology adopted indicating the pressure drop.** (Mandatory Requirement)

Cubicle 1

Air flow rate	Front	:	1100 m^3/h
	Rear	:	550 m^3/h
Air speed	Front	:	2.5 m/s
	Rear	:	5.0 m/s
Pressure	Front	:	30 Pa
	Rear	:	6 Pa

Cubicle 2

Air flow rate	Front	:	1700 m^3/h
	Rear	:	1100 m^3/h
Air speed	Front	:	5 m/s
	Rear	:	5 m/s
Pressure	Front	:	30 Pa
	Rear	:	20 Pa

The existing arrangements for the cooling of the auxiliary converter shall be preferred. However, the tenderer shall furnish detailed alternative arrangement if existing arrangement is found inadequate.

5.13 Locomotive cable interface:

It is proposed that the cables for connection to the locomotive should be in the bottom of the panel. Following are the sizes of various cables proposed to be used. However, this may change as per the requirements and needs and shall be discussed & finalised after placement of order. Electron Beam irradiated cables shall be used for internal wiring.

(a) Transformer auxiliary winding to input of static converter panel -- 70 mm^2 cable.

(b) Output of static converter – 50 mm^2 cable.

(c) Battery charger to battery base -- Two 10 sq mm cable.

Control cables are connected from upper side of the cubicle through a round socket connector. However, finalisation of cable outlets shall be done during design approval after award of contract.

Location of input & out put terminal should be same as the one in existing Aux converter to provide for interchange ability of different makes of Aux converter.

5.14 General design feature

5.14.1 Safety factor

(a) In the circuit configuration, 25% safety margin in the rating of both voltage and current under worst conditions is to be ensured. This should be established in the offer with calculation.
(b) A minimum thermal margin of 10ºC for junction temperature under worst operating condition for the power devices is required. Over load margins and duration are to be furnished.

5.14.2 Current density of the bus bars: 4A / sq. Mm

5.14.3 **Acoustic Noise:**

Acoustic Noise generated by circuits and components should be as low as possible, less than 80 dB (A) at a distance of 1 M from the equipment.

5.14.4 The cards shall be provided with LED indication to show the health of cards, to assist maintenance and operating personnel in trouble shooting.

5.14.5 The power portion of the equipment should be suitably protected to prevent accidental contact. The shields and screens shall be properly earthed.

5.14.6 Reliability

Component to be selected and tested as per international reliability assurance specification including burn-in test and necessary de-rating for traction duties. The components are to be sourced from reputed sources. MTBF of the equipment will be furnished by bidder.

5.14.7 Maintainability:

The use of general purpose ICs should be encouraged and use of ASICs restricted for better maintainability. Modular system with plug in and easily replaceable control cards with polarization for non-interchangeability shall be provided. Accessibility to components / subassemblies requiring frequent maintenance should be ensured. Access is available only from the corridor sides.

5.14.8 Marking:

The major equipments / subassemblies should bear marking and serial number. The equipment should contain serial number and make of bidder.

(a) All equipments / cubicles shall contain name plates of anodised aluminium with engraved / punched letters.

(b) The inverter rating plate shall be marked with the following information:

(i) Type / Make
(ii) Contract number
(iii) Month and year of manufacture / batch no. / Serial no.
(iv) Rating
-- KVA
-- Input voltage range
-- Output voltage, frequency and wave shape

5.14.9 Cable:

The use of wires / cables shall be reduced to minimum. Bus bars will be of high grade copper and insulated bus bar is preferable. The wires / cables shall be of high grade, copper with halogen free thin walled insulations. All the cable terminations shall be made through crimped sockets / lugs and wires with circuit and diagram furnished. Each cable / wire shall be numbered at both ends for easy identification. The use of pre-insulated lugs suitable for double crimp for insulation and conductor is recommended. Current collection through threads must be avoided and terminals of adequate size shall be provided.

Cable grommets / glands of suitable size as required for input and output cables shall be provided at cable entry / exit.

5.14.10 **Input Power Interface**

(a) The static converter will be supplied through the auxiliaries winding of the locomotive transformer.
(b) R-C snubber is placed across the auxiliary winding with R = 22 Ω, 320 W and C = 0.66 μF, 2000V. In addition toroid cores are inserted in the input cables to minimise the di/dt and interaction between multiple converters across same winding.
(c) The catenary voltage can vary from 19.0kV to 30kV. However, voltage may dip down to 17.5kV which may lasts for upto half an hour.
(d) Input power frequency = 50Hz ± 8%
(e) Panto bouncing duration upto 45 ms (limit of zero pressure contact) should not affect static converter with or without loads.

5.14.11 **Signal and telecommunication installation:** The tracks over which the locos will run may be equipped with 83-1/3 Hz track circuit as well as track circuits at higher frequencies. Similarly, other devices like axle counters, block instruments, point machines etc., may also be employed. On the communication network, control circuit, tele-printer circuit as well as VHF / UHF and micro-wave circuits are employed.

CHAPTER – 6: SCOPE OF SUPPLY FOR 3 X 130 KVA AUXILIARY CONVERTERS

6.1 The scope of supply covers design and development of complete set of 3 nos. 130 kVA IGBT based static converter for 25kV AC 3 phase locomotive, including battery charger to meet the 110V DC load requirement. Contactors as provided on the existing locomotives for switching and transferring of loads shall be retained. Their location and control shall be decided mutually between BHEL/IR/CLW and the successful bidder and BHEL/CLW will incorporate logic for contactor operation in the locomotive control.

6.2 Bidder shall supply suitable software for offline analysis of diagnostic data downloaded from the auxiliary converter.

6.3 The Auxiliary Converter should have provision for cab air conditioning (Rating 2 KW in each cab), which may be adopted in future. The tenderer should also submit the complete proposal consisting of related hardware and software.

6.4 Commissioning of complete set of 3 nos. 130 kVA IGBT based auxiliary converter on the locomotive.

6.5 Five days training for six persons per location is to be offered for IR personnel for training in the field of maintenance and troubleshooting. For the ordered quantity of 10 sets, training shall be provided for the personnel of maximum two locations. The wages and allowances as well as the cost of the passage to and from the place of training for IR personnel will be borne by Indian Railways.

6.6 Detailed operation and maintenance manual.

6.7 The bidder shall quote for a portable data logging and processing unit, preloaded with suitable software for down loading and analysing the failure data of the equipment. This unit will be with Pentium-5, 128 MB RAM, 40 GB hard disc, Window 2000 or the latest or as available in the market to process the diagnostic data 4.8Testing jigs for troubleshooting at card level.

6.8 List of spares for 5 years maintenance.

6.9 Repair charges for the PCBs.

Tenderer shall separately quote for the item mentioned under clause no. 6.7 - 6.9

CHAPTER 7 -TESTS & TRIALS FOR 3 X 130 KVA AUXILIARY CONVERTERS

7.1 The converter shall be tested in accordance with IEC61287, IEC411.5 & the control electronics shall be tested as per IEC60571.

7.2 The list of tests to be carried out is as follows:

S.No.	Test	Clause	Type	Routine
1.	Visual inspection	IEC 1287 clause 2.4.6.1	√	√
2.	Tolerance & dimension	IEC 1287 clause 2.4.6.2	√	√
3.	Weight	IEC 1287 clause 2.4.6.3	√	
4.	Cooling	IEC 1287 clause 2.4.6.5	√	
5.	Protection and measuring	IEC 1287 clause 2.4.6.6	√	√
6.	Trigger equipment	IEC 1287 clause 2.4.6.7	√	√
7.	Light load	IEC 1287 clause 2.4.6.9	√	√
8.	Noise measurement	IEC 1287 clause 2.4.6.11	√	
[9.	Temperature rise	IEC 1287 clause 2.4.6.12	√	
[10.	Power loss determination	IEC 1287 clause 2.4.6.13	√	
11.	Supply over voltage & transient	IEC 1287 clause 2.4.6.14	√	
12.	Short circuit	IEC 1287 clause 2.4.6.15	√	
[13.	Sudden variation of load	IEC 1287 clause 2.4.6.15	√	
14.	Insulation	IEC 1287 clause 2.4.6.16	√	√
15.	Dielectric	IEC 1287 clause 2.4.6.17	√	√
16	Vibration & shock	IEC 1287 clause 2.4.6.21	√	
17	Interference on control electronics	IEC 1287 clause 2.4.6.23	√	
18	Short time interruption	IEC411.5 clause 4.3.8	√	
19	DC link discharge	IEC411.5 clause 4.3.11	√	
20	Rated current load	IEC411.5 clause 4.2.7	√	
21	Output voltage & frequency range	IEC411.5 clause 4.3.3	√	

22	Performance test by fault simulation	IEC60571 clause 10.2.2	√	√
23	Voltage surge on control electronics	IEC60571.1 clause 10.2.6.2	√	
24	Electrostatic discharge test on control electronics	IEC60571.1 clause 10.2.6.4	√	
25	Transient burst susceptibility test	IEC60571.1 clause 10.2.7	√	
26	Radio interference test on control electronics	IEC60571.1 clause 10.2.8	√	
27	Damp heat on control electronics	IEC60571.1 clause 10.2.5	√	
28	Dry heat on control electronics	IEC60571.1 clause 10.2.4	√	

Tests marked ([) can be conducted at end user premises with real load.

7.3 The bidders shall submit complete test programme for type and routine test to BHEL/CLW for its approval. BHEL/CLW may also decide to carry out certain special tests on the equipment, which are not covered by relevant IEC specification. Bidder/Manufacturer will carry out the test as per mutually agreed test programme at his own cost.

7.4 The prototype static converter units will be inspected & tested by the engineers of BHEL/CLW at the bidder/manufacturer premises or at mutually decided venue where all the facilities should be made available for carrying out the prototype test. The equipments will be kept in field trials for a period of six months. The BHEL/CLW engineers will associate and witness the tests in the locomotive also till they are successfully completed. Any defects noticed / design improvement found necessary as a result of the test / trial shall be carried out by the bidder in the least possible time.

7.5 The individual equipments, system and sub-system as may be necessary shall be type tested and routine tested in accordance, with relevant IECs.

7.6 Necessary arrangement should be made by the successful bidder to carry out certain tests to establish conformance to specified requirements e.g. dv/dt, THD etc.

7.7 Type test will be performed on one unit of given design to verify that the product meets the requirements specified and agreed upon between users & manufacturer. Type test will also be repeated in following cases:

-- Modification of equipment, which is likely to affect its function.
-- Failure or variations established during type or routine test.

7.8 Routine tests are to be carried out to verify that properties of the product corresponding to those measured during type tests. Routine test are to be carried out by the manufacturer on each equipment.

7.9 Investigation tests are intended to obtain additional information regarding the performance of the product. They shall be specially requested by the end user.

7.10 Instrumentations

(a) All the instruments used for testing should be duly calibrated. The calibration certificates are to be shown to inspecting authority on demand.
(b) Value of the fundamental component and THD of inverter output will be measured by power analyser during the prototype test. True value of output voltage rms is also to be measured for record.
(c) Input power factor and the efficiency will be measured by using power analyser at rated load of 130 kVA at 0.8 pf.

7.12 The following clarifications are issued on the tests included in 7.2

(a) **Visual inspection** - The object of visual inspection is to check that the equipment is free from defects and the equipment is as per approved drawing. Bill of materials should be submitted. The make, rating of equipments, subassemblies will be checked with the details as per approved design proposal submitted in design proposal. If change is needed in make or rating of important equipments, sub-assemblies, it should be intimated and should have approval of BHEL/CLW. Static converter with modified equipments, subassemblies will be given separate revision number. All the important dimensions will be measured and should be in permissible tolerance.

(b) **Power loss determination test** - This test will be done at voltage corresponding to 22.5kV in OHE. The efficiency will be measured at full and 80% of load at 0.8 pf. The performance at different input voltage will be monitored. The measurements will be taken at 17.5kV, 19kV, 22.5kV, 25kV, 27kV and 30 kV.

(c) **Earth fault** - Simulate the earth fault by connecting a suitable resistor between cubicle frame and output phases. The inverter should not trip and earth fault indication will be in "OFF" state till the leakage current is less than 10 mA. If the leakage current will exceed 50 mA, the earth fault will occur.

(e) **Cooling test** - The purpose of this test is to verify that the cooling of various components / assemblies. The air flow rate will be measured to confirm compliance with that claimed by the manufacturer.

(f) **Insulation resistance and Dielectric test** - The insulation resistance with 1000 V megger shall not be less than 100 M ohms at 70% RH for all the circuits. The dielectric test shall be carried out after shorting semiconductor device, pulse transformer earthed, earthed special cards if necessary before applying dielectric voltage. The corresponding voltages are given below.

The following are the voltage and leakage current setting

- Input circuit -- the test is to be done at 3.3 kVrms for 60sec. The leakage current to be less than 10 mA.
- 110V control side – 1.5 kV AC for 60 sec. The leakage current will be less than 1 mA.
- 24V electronics side – 500 V AC for 60 sec. The leakage current to be less than 1 mA.
- Battery charger – (415V side) 2 kV for 60 sec. The leakage current to be less than 1mA.

(g) **Temperature rise test:** The static converter shall be loaded to full load for 6 hours with input OHE voltage of 19kV and with 50% blockade of the inlet filters, if used. The temperature rise shall be recorded by temperature detectors mounted at the specified reference points on the body of semiconductors, capacitors, and other components as agreed between purchaser and manufacture. The maximum recorded temperature under worst condition shall be corrected for 55ºC and compared with maximum permissible temperature. (For power devices at junction). The thermal margin available shall be compared with the safety margin declared by the manufacturer. The temperature of the power devices shall have a margin of minimum 10ºC. The inverter shall also be subjected for short time rating after continuous loading to ensure the temperature rise in within the permissible limit. The maximum temperature rise of the electronic devices on the PCBs should not exceed approximately 20ºC above its ambient. In case it is exceeding the limit, use of mil-grade component can be considered keeping CLW and its authorised representative informed.

(h) **Damp heat test:** Function test of electronic rack will be carried out after the damp heat test.

(i) **DC link discharge:** The DC link voltage should come down below 50V within 5 minutes.

(j) **Short time rating:** 450 Amp ± 10 % for 6 to 10 Sec.

CHAPTER 8- CLIMATIC & ENVIRONMENTAL CONDITION

8.1 **Temperature**

Maximum temperature inside stabled Locomotive under sun	:	70°C
Maximum temperature inside working loco	:	55°C
Minimum temperature	:	0°C

The equipment shall be able to start up at the maximum specified temperature inside the locomotive without any pre-cooling requirement.

8.2 **Humidity:** Up to 100% during rainy season.

8.3 **Altitude:** Upto 1000 m above mean sea level.

8.4 **Rainfall:** Very heavy in certain areas. The propulsion equipment shall be designed suitably.

8.5 **Atmosphere during hot weather:** Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/cub. In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.

8.6. **Coastal area:** The equipment shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition will be as follows:

a)	Maximum pH value	:	8.5
b)	Sulphate	:	7 mg per litre
c)	Max. Concentration of chlorine	:	6 mg per litre
d)	Maximum conductivity	:	130 micro siemens /cm

8.7 **Vibration:** The equipment shall be designed suitable for Indian conditions to withstand the vibrations and shock encountered in service satisfactorily as specified in IEC 61287 and IEC 60571 publications for the converter and electronic equipments.

8.8 **Electromagnetic Pollution** – High degree of electromagnetic pollution is anticipated in locomotive machine room, where the equipment will be mounted. Necessary precaution should be taken in this regard.

Annexure-1

SALIENT DATA OF LOCOMOTIVES

SN	Characteristics	Unit	WAP-5	WAP-7	WAG-9
1	Guaranteed performance at 22.5 kV and half-worn wheels				
a	Max. service speed	kmph	160	140	100
b	Cont. rated speed	kmph	50	70	50
c	Starting tractive effort	kN	258	322	460
d	Cont. rated Tractive Effort	KN	220 (0-50 kmph)	228 (0-71 kmph)	325 (0-50 kmph)
e	Cont. rated power at wheel rim	KW	4000 (80-160kmph)	4500 (71-140 kmph)	4500 (50-100 kmph)
f	Max. regenerative braking effort	KN	160 (10-90 kmph)	182 (10-89 kmph)	260 (10-62 kmph)
2	Axle Arrangement	-	Bo-Bo	Co-Co	Co-Co
3	Gear Ratio		3.941	3.6	5.1
4	Traction Motor type	-	6FXA 7059	6FRA 6068	6FRA 6068
5	No. of Traction Motors	-	4	6	6

Annexure – 2

DETAILS OF TRACTION TRANSFORMER (NOT IN THE SCOPE OF SUPPLY)

SN	Parameter		Value
1	Type		LOT-6500 / LOT 7500
2	Original Design		Secheron SA
3	Windings		
		Traction	4
		Auxiliary	1
		Filter	1
4	Frequency (f nom)		50 Hz
5	Primary Voltage		
		Maximum	30.0 kV
		Nominal	25.0 kV
		Minimum	17.5 kV
6	Voltage Ratings (at 25.0 kV Catenary)		
		Traction	1269V
		Auxiliary	1000V
		Filter	1154V
		Hotel Load*	750 V
7	Current Ratings		
		HT	261.25 A
		Traction	4 x 1142 A
		Auxiliary	334 A
		Filter	347 A
		Hotel Load*	1260 A
8	Thermal Ratings		
		Primary	6531 kVA
		Traction	4 x 1449 kVA
		Filter	400 kVA
		Hotel Load*	945 kVA
9	Winding Data		
		Traction	37.0 mΩ, 2.1 mH $\pm$ 15%
		Auxiliary	60.0 mΩ, 0.43 mH
		Filter	19.0 mΩ, 0.29 mH
		Hotel Load*	11.0 mΩ, 0.37 mH

*** Hotel Load winding is available only in LOT 7500**

Annexure-3

CHARACTERISTICS OF TRACTION MOTORS

SN	Characteristics	Unit	6FXA 7059	6FRA 6068
1	Continuous Rating			
a	Shaft output	kW	1150	850
b	Nominal voltage	V	2180	2180
c	Current	A	370	270
d	Speed	rpm	1585	1283
e	Torque	Nm	6930	6330
f	Frequency	Hz	80	65
g	Power Factor	-	0.86	0.88
2	One Hour Rating			
a	Shaft output	kW	1150	850
b	Nominal voltage	V	2044	2089
c	Current	A	396	290
d	Speed	rpm	1485	1135
e	Torque	Nm	7420	7140
f	Frequency	Hz	75	57.5
g	Power Factor	-	0.86	0.86
3	Short Time Overload Rating			
a	Shaft output	kW	1150	850
b	Nominal voltage	V	1540	1660
c	Current	A	540	370
d	Speed	rpm	1107	892
e	Torque	Nm	9920	9100
f	Frequency	Hz	56.5	45.7
g	Power Factor	-	0.85	0.86
4	Max. speed	rpm	3174	2584
5	Temperature sensor	2 Pt. 100 resistance elements installed in stator tooth.		
6	Speed sensor	Wiegand transmitter system with transmitter ring for 120 pulses per rotor revolution.		

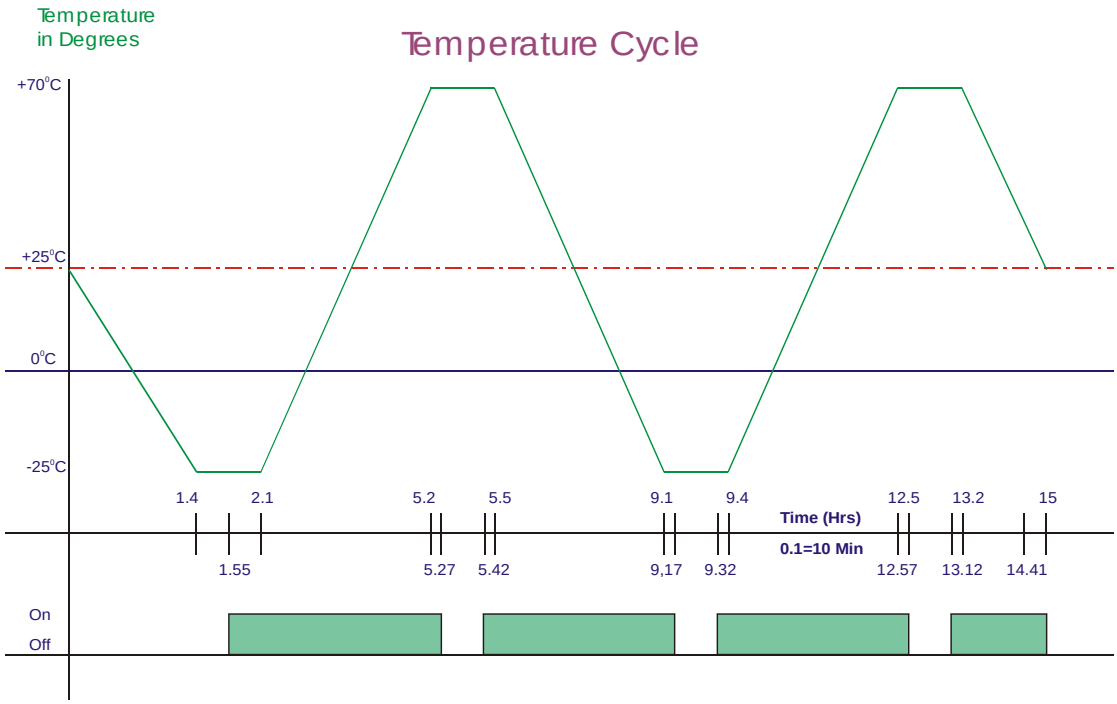
Annexure-4

CHARACTERISTICS OF VCB

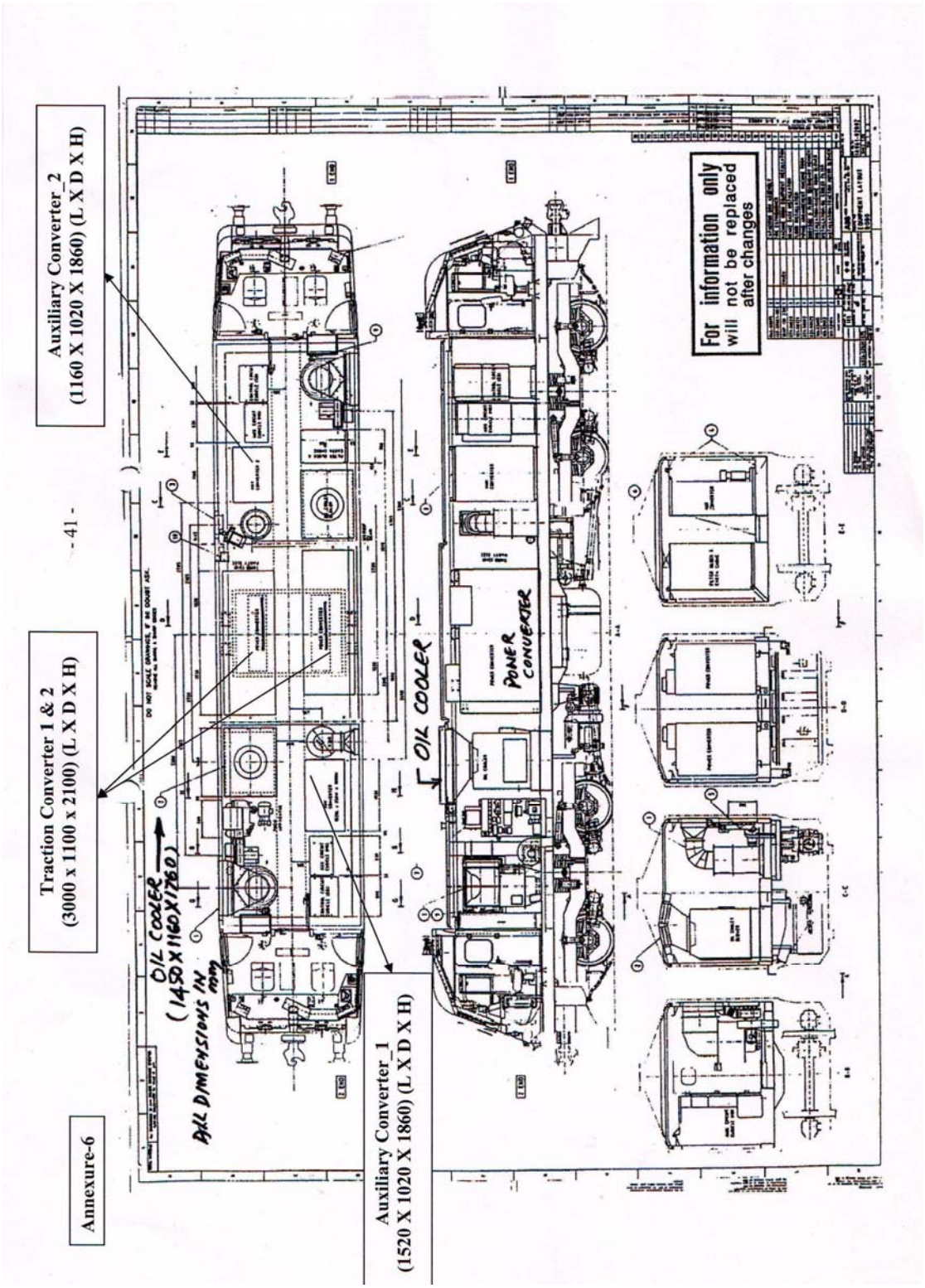
SN	Parameter	Value
1	Type	Single bottle
2	Original Design	Secheron, Alstom
3	Number of Poles	Single
4	Control System	Electro-pneumatic
5	Rated operational voltage (Ue)	27.5 kV
6	Nominal voltage (Un)	25 kV
7	Dielectric test voltage	75 kV
8	Rated impulse withstand voltage (Uimp)	175 kV
9	Conventional free air thermal current (lth)	1000A
10	Rated frequency	50/60 Hz
11	Rated breaking capacity	16 kA
12	Opening time	30 to 60 milli-sec
13	Auxiliary voltage	110 V DC
14	Number of auxiliary contacts	4 + 4
15	Air Supply Pressure	4.5 – 10 bar
16	Approximate weight	140 Kg (Approximately)

Annexure-5

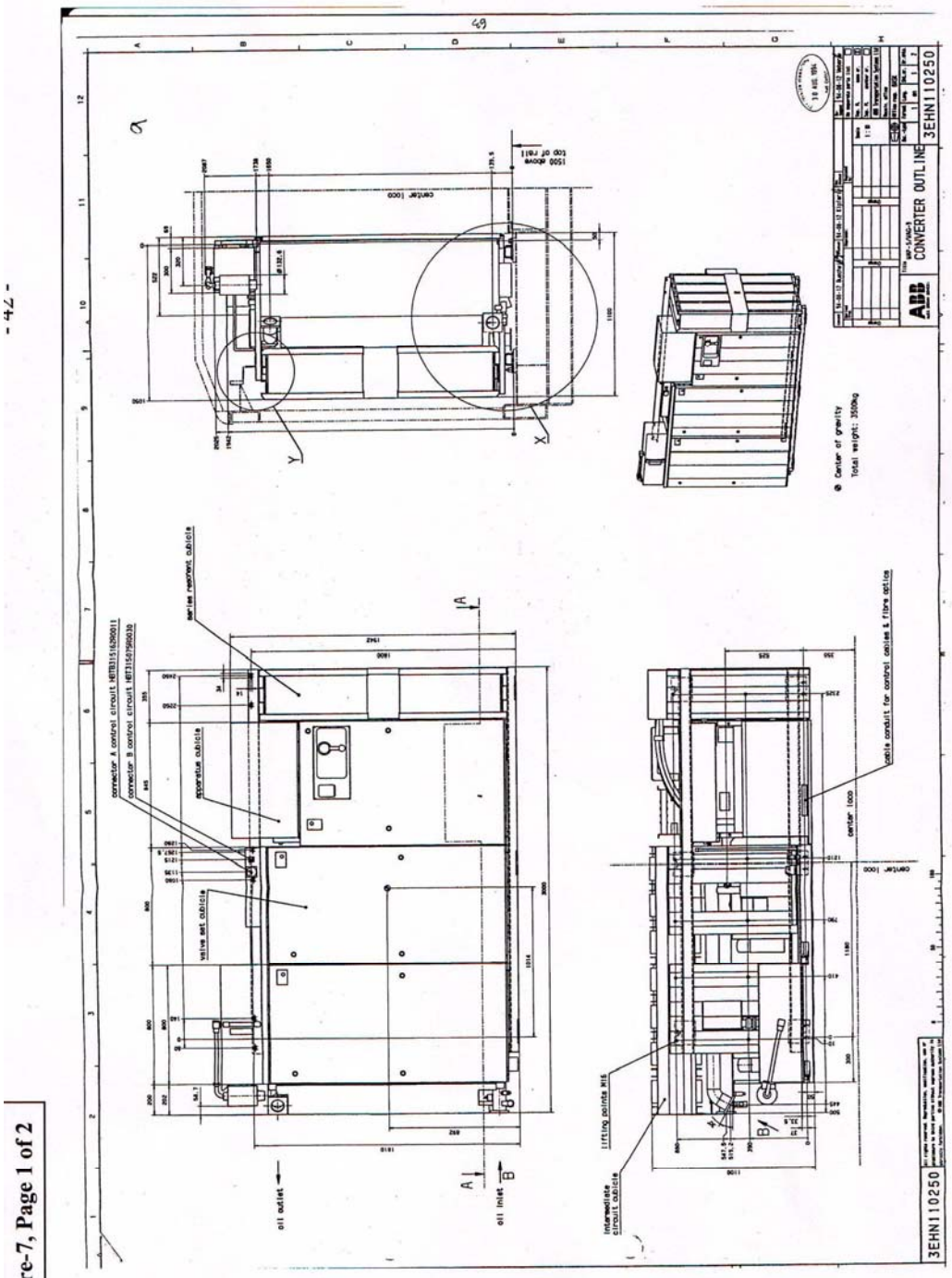
BURN-IN TEST



Annexure-6

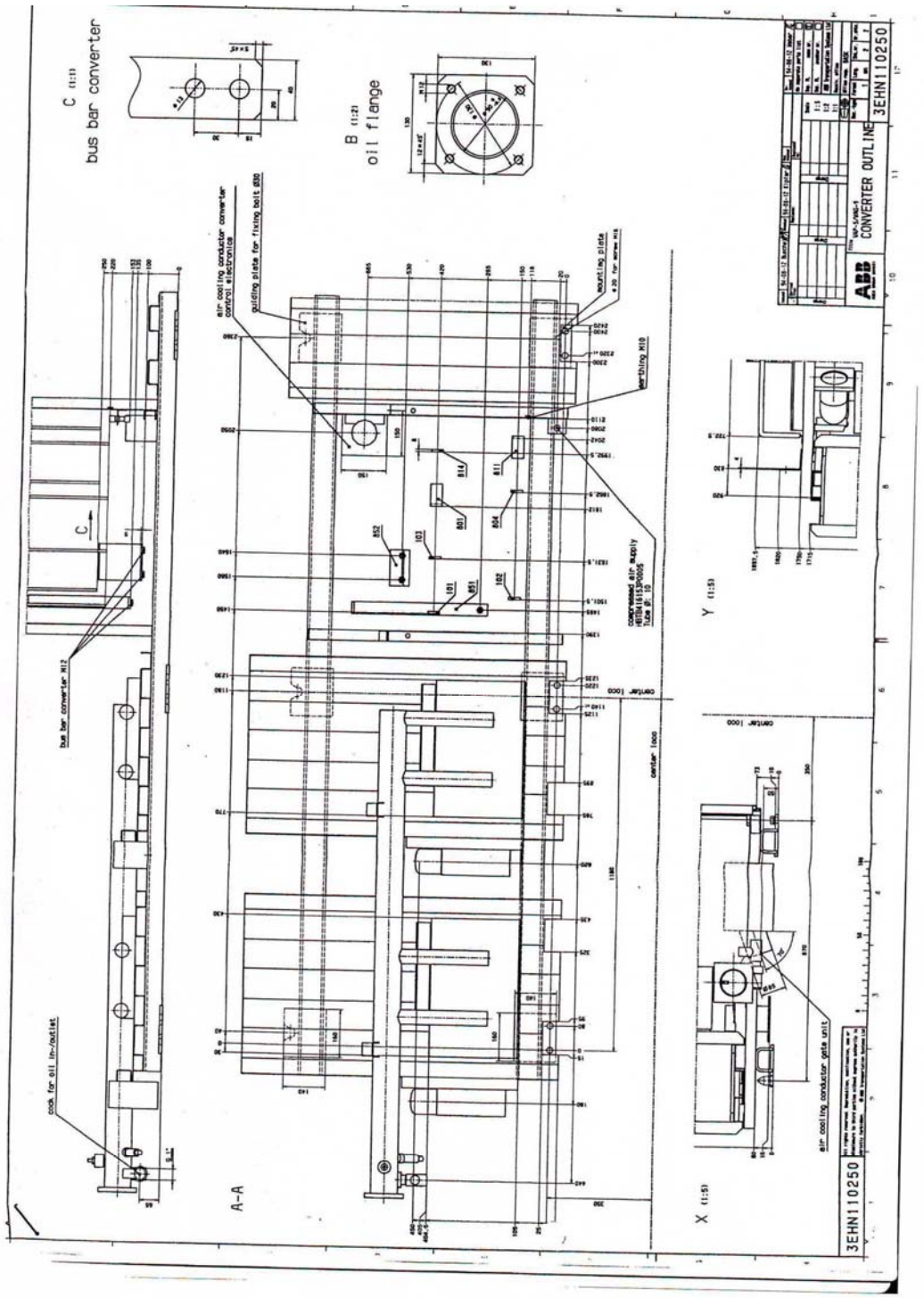


Annexure-7, Page 1 of 2



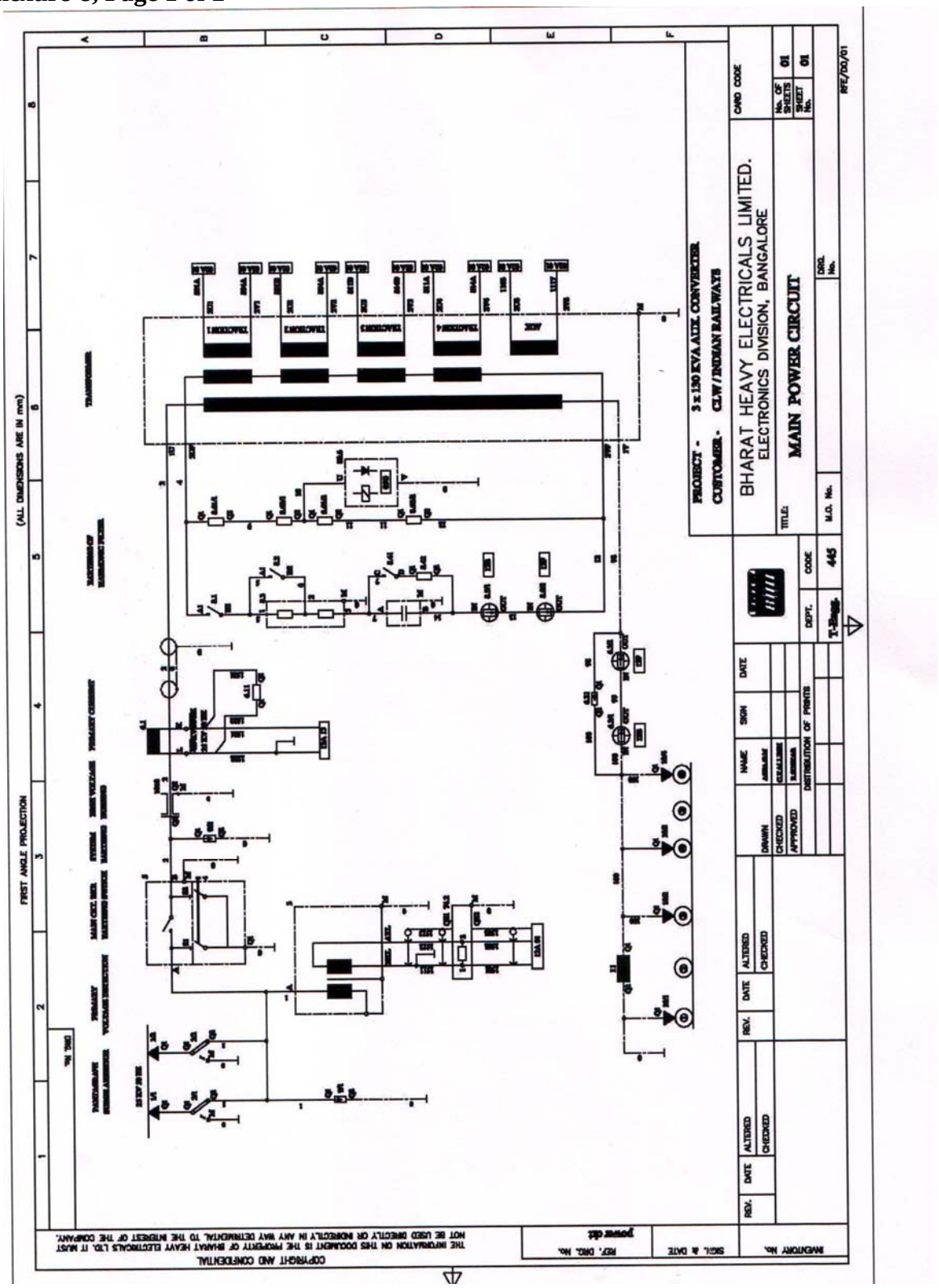
Annexure-7, Page 1 of 2

Annexure-7, Page 2 of 2

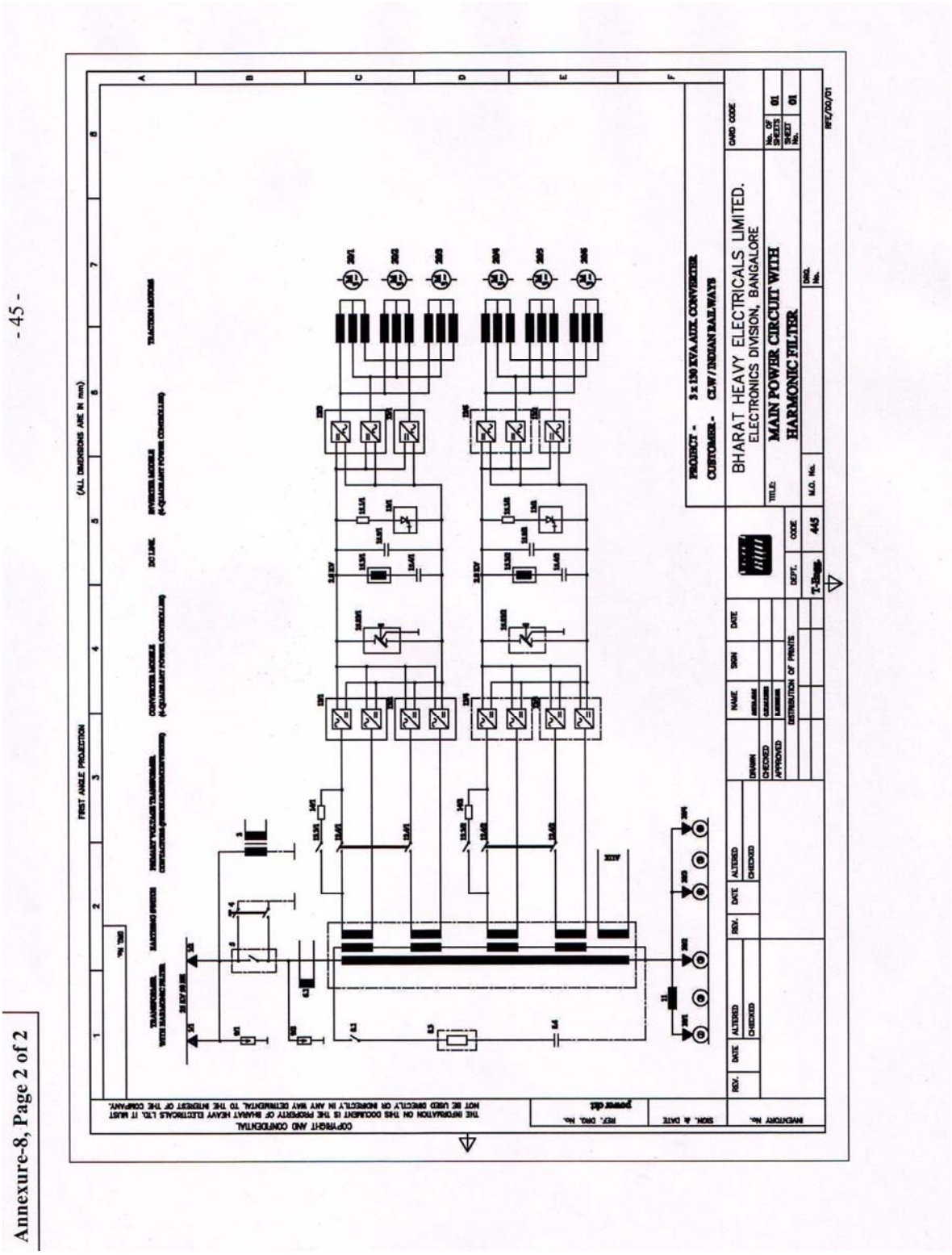


Annexure-7, Page 2 of 2

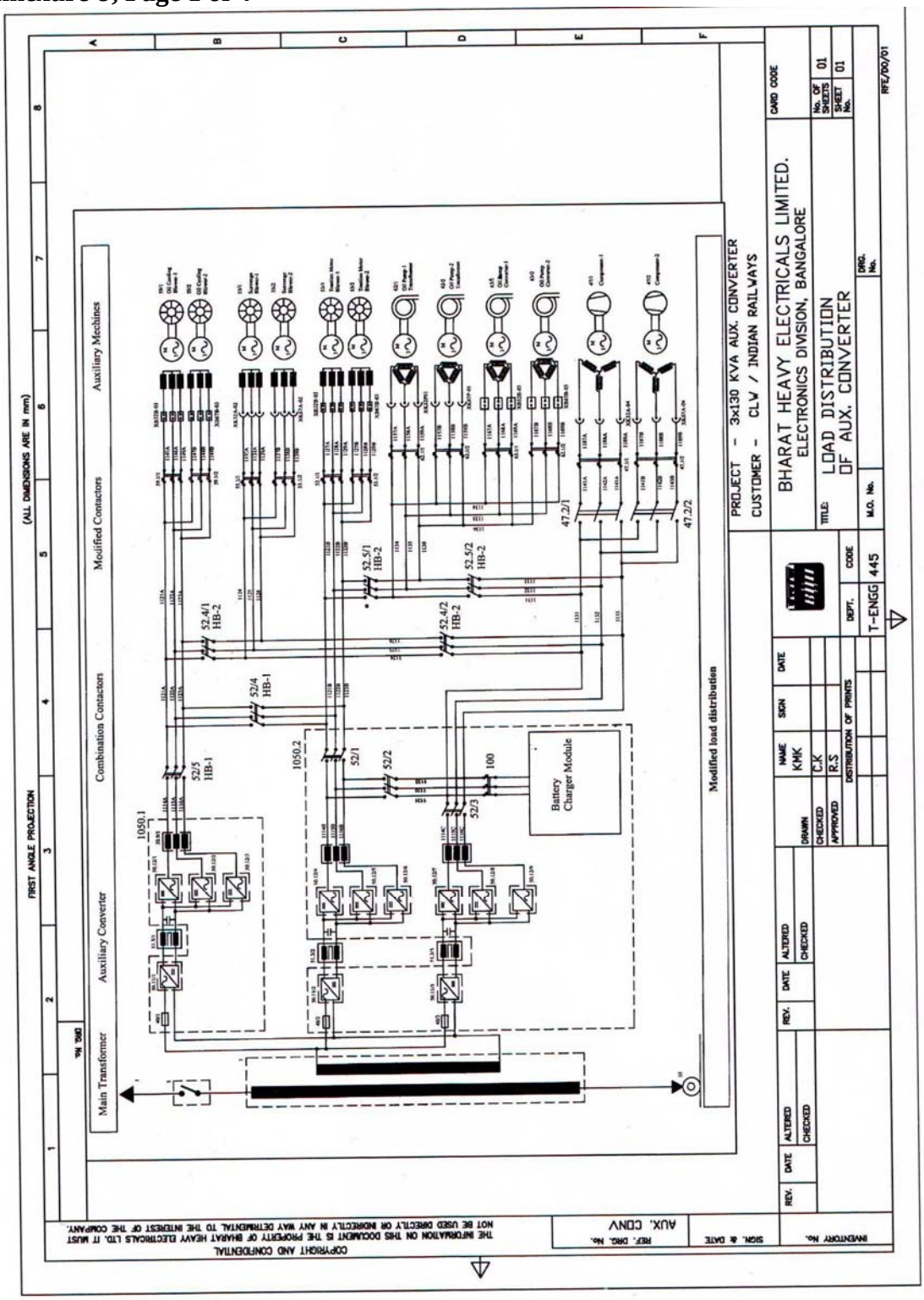
Annexure-8, Page 1 of 2



Annexure-8, Page 2 of 2



Annexure-9, Page 1 of 4



Annexure-9, Page 2 of 4

Existing load connections (Revised load distribution with modification release 434)

Aux_1 : Both oil cooling units
Aux_2 : Both traction motor blowers & all four oil pumps
Aux_3 : Both compressors both scavenge blowers & battery charger

Distribution with Three Converters

Following are the load distribution. However, IR reserves right to redistribute the load as per its requirement. This distribution is for 3×130 KVA concept.

Auxiliary Converter 1		
	Oil cooler blower-1	25 KW
	Oil cooler blower-2	25 KW
	Total	**50 KW**

Auxiliary Converter 2		
	Traction motor blower -1	25 KW
	Traction motor blower -2	25 KW
	Oil pump transformer – 1	4.7 KW
	Oil pump transformer – 2	4.7 KW
	Oil pump converter – 1	11 KW
	Oil pump converter – 2	11 KW
	Total	**81.4 KW**

Auxiliary Converter 3		
	Scavenge blower – 1	3 KW
	Scavenge blower – 2	3 KW
	Compressor – 1	15 KW
	Compressor – 2	15 KW
	Battery charger	12 KVA
	Total	**48 KW**

Annexure-9, Page 3 of 4

When Auxiliary Converter _1 ISOLATED

Auxiliary Converter 2		
	Traction motor blower -1	25 KW
	Traction motor blower -2	25 KW
	Oil cooler blower – 1	25 KW
	Oil cooler blower – 2	25 KW
	Scavenge blower – 1	3 KW
	Scavenge blower – 2	3 KW
	Total	**106 KW**

Auxiliary Converter 3		
	Oil pump transformer – 1	4.7 KW
	Oil pump transformer – 2	4.7 KW
	Oil pump converter – 1	11 KW
	Oil pump converter – 2	11 KW
	Compressor – 1	15 KW
	Compressor – 2	15 KW
	Battery charger	12 KVA
	Total	**73.4 KW**

When Auxiliary Converter 2 ISOLATED

Auxiliary Converter 1		
	Traction motor blower -1	25 KW
	Traction motor blower -2	25 KW
	Oil cooler blower – 1	25 KW
	Oil cooler blower – 2	25 KW
	Scavenge blower – 1	3 KW
	Scavenge blower – 2	3 KW
	Total	**106 KW**

Auxiliary Converter 3		
	Oil pump transformer – 1	4.7 KW
	Oil pump transformer – 2	4.7 KW
	Oil pump converter – 1	11 KW
	Oil pump converter – 2	11 KW
	Compressor – 1	15 KW
	Compressor – 2	15 KW
	Battery charger	12 KVA
	Total	**73.4 KW**

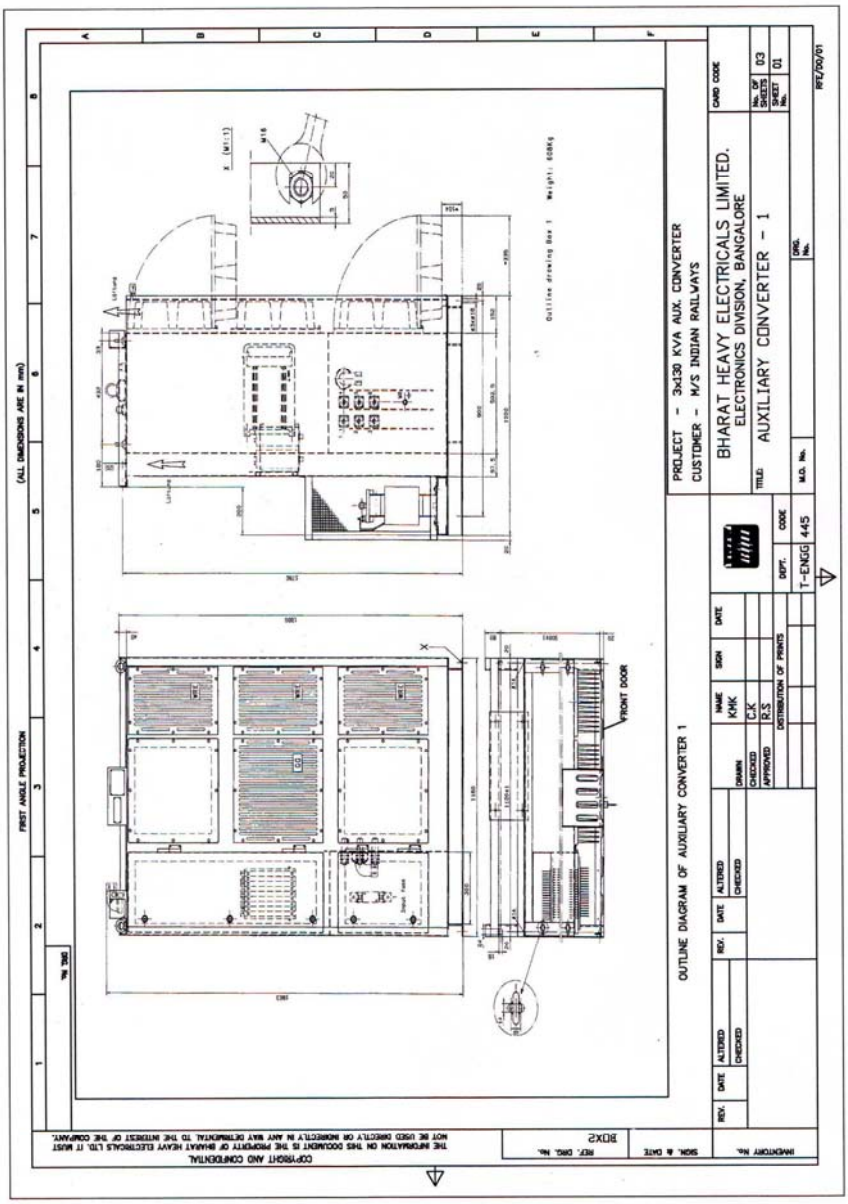
Annexure-9, Page 4 of 4

When Auxiliary Converter 3 ISOLATED

Auxiliary Converter 1		
	Traction motor blower -1	25 KW
	Traction motor blower -2	25 KW
	Oil cooler blower – 1	25 KW
	Oil cooler blower – 2	25 KW
	Scavenge blower – 1	3 KW
	Scavenge blower – 2	3 KW
	Total	**106 KW**

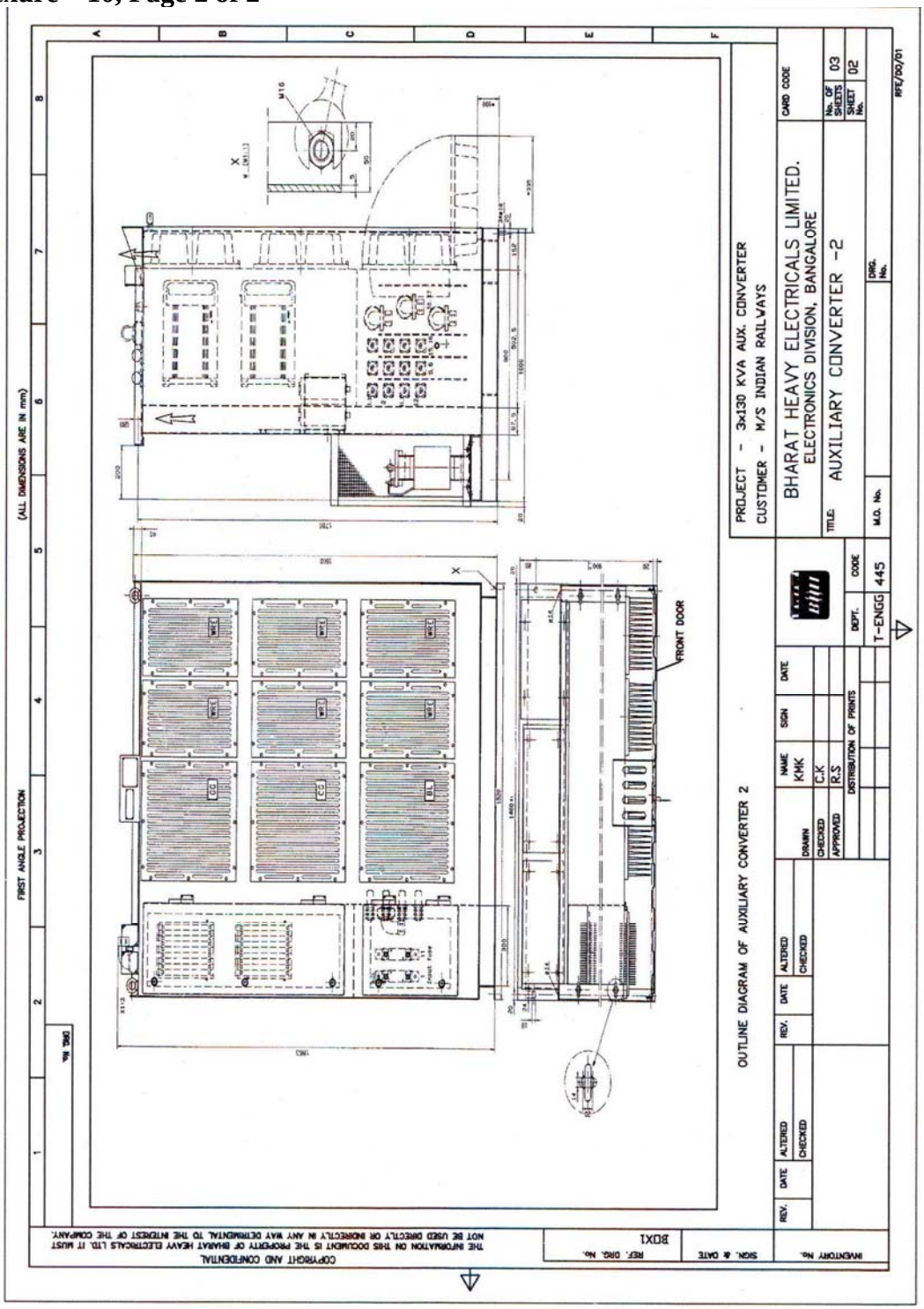
Auxiliary Converter 2		
	Oil pump transformer – 1	4.7 KW
	Oil pump transformer – 2	4.7 KW
	Oil pump converter – 1	11 KW
	Oil pump converter – 2	11 KW
	Compressor – 1	15 KW
	Compressor – 2	15 KW
	Battery charger	12 KVA
	Total	**73.4 KW**

Annexure – 10, Page 1 of 2

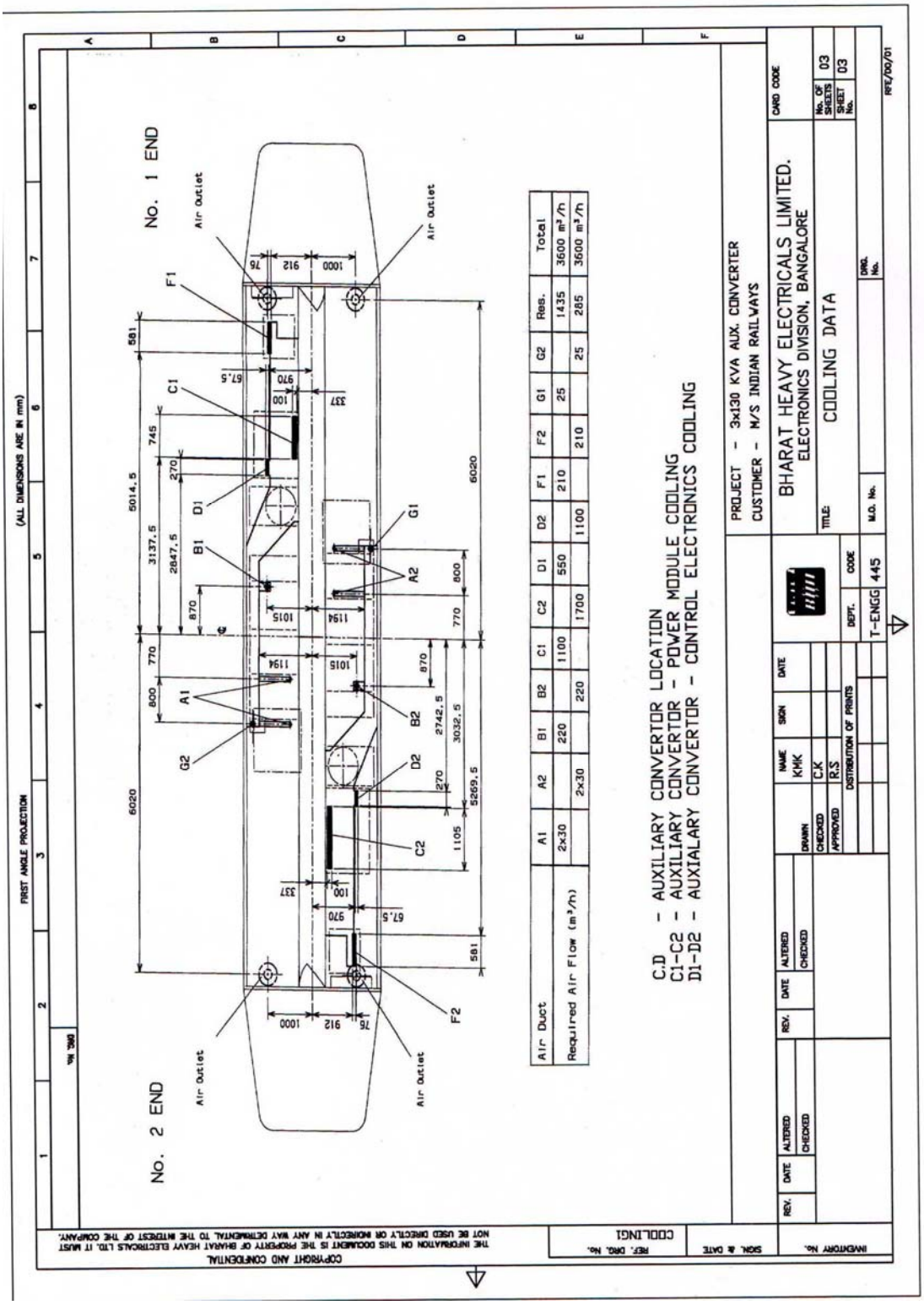


Annexure – 10, Page 1 of 2

Annexure – 10, Page 2 of 2



Annexure – 11



Annexure – 12, Page 1 of 5

Transfer of Documentation

A Traction Converter, Auxiliary Converter with Battery charger

1. Configuration/Topology /layout (Electrical scheme and mechanical layout with dimension)
2. Block diagram and Logic Flow Diagrams
3. Design calculation data for all systems & sub systems for electric design, circuit design & mechanical design including design criterion, values & limiting values.
4. Power Device selection, ratings, Make etc.
5. Cooling schedule giving details of cooling data confirming to the data given in the tender specification
6. Control Philosophy and control system overview (functional description)
7. Protection with philosophy
8. Operating System and Software details
9. Thermal calculation, analysis and simulation, details of settable parameters and their range. Heat sink selection etc. simulation software
10. Logic flow diagram for controls, listing of software with source code, details flow diagram, details of settable parameters and their range.
11. Load distribution details in Auxiliary Converter
12. Functional Details Automatic Change over in case of failure of Aux. Converter
13. Electromagnetic Compatibility
14. Reliability, Availability, Maintainability and Safety studies and calculations
15. Standards

Annexure – 12, Page 2 of 5

B **Manufacturing Information for Traction Converter, Auxiliary Converter with Battery Charger**

1 General arrangement drawing

2 Tree structure based bill of material covering all the items including hardwares

3 Mechanical drawings with tolerances for all the components and final structure

4 Power scheme wiring diagram and cable schedule with harness details

5 Control electronics wiring diagram and cable schedule with harness details

6 Process details (manufacturing and assembly instructions), special jigs and fixtures

7 Test schedule and test instruction for complete assembly covering routine, type and special tests

8 Test software with Logic flow diagram, listing of software with source code, details flow diagram, details of settable parameters and their range. Test jigs, special tools and instrumentation with specification and sources . Manufacturing and testing information for tools / test jigs designed by Bidder.

9 Specification, sources, dimensions of all the items with technical catalogs including bought out items Only technical catalogues for special items, not for standard and on internet available items

10 Specification for MVB/ Digital I/O Signal Communication details with Vehicle Control Electronics

Annexure – 12, Page 3 of 5

C Information for each PCB including processor card and Gate drivers of traction converter, auxiliary converter and battery charger

1 Schematics

2 Gerberfile

3 Bill of Material with specification, dimensions, source, catalogs, etc. for special components/items.

4 Datasheet

5 Technical Description

6 Test Instruction

7 Type test instruction & Report

8 Functional Description Boot Loader

9 Detail design Boot Loader

10 Functional Description BSP

11 Detail design BSP

12 FPGA Interface description

13 FPGA detail design

14 FPGA software listing

15 Vehicle Interface Functional Description

16 Download file FPGA

17 Other down load files if applicable

D Handling

1 Handling, Storage and transportation instruction for assemblies & sub assemblies and finished products.

E Quality

1 Quality Assurance Plan

Annexure – 12, Page 4 of 5

F Erection / Mounting & Commissioning Documentation

1 External dimension drawings indicating weight and center of gravity.

2 Detailed auxiliary and control schematics complete with wire nos, equipment & its termination details, etc.

3 Converter commissioning instructions/procedure including checklist list of required tools and equipment etc.

4 All type test procedures/documents, results/reports

4.1 For modules, sub assemblies and assemblies

4.2 system level testing at part load and full load

G Service and Maintenance Documentation

1 Maintenance manuals (including after sales check book = maintenance schedule) for all Bidder deliverables including disassembly/ assembly instructions, maintenance frequency etc.

2 Part catalogues.

3 Specifications of all consumable parts.

4 Fault finding instructions.

5 On board repair instructions.

6 Workshop repair instructions.

7 Feedback reporting system for rectifying service problems.

9 Final customer documentation

Annexure – 12, Page 5 of 5

H General remarks on drawings, information's, textboxes etc

1 All Test Software as available, for testing of Software with source code , PCB's,Power Stacks/Other Subassemblies , equipment and SYSTEM

2 Manufacturing information of In Circuit-Tester (ICT) Jigs and Fixtures and ICT Test Software with source code

3 Schemes, drawings & BOM for PCB textboxes and textboxes for auxiliary converter with battery charger.

4 For design approval of RDSO/IR, any other required documents not listed above shall be supplied by Bidder

5 In First angle projections and also in 3D preferably in AUTODESK INVENTOR

6 All drawings shall be as per international standards (A4 and its siblings).

7 Any other information, software, documents required to complete the system shall be supplied

8 All SOFTWARE except commercially available software, have to be supplied to BHEL and should include Logic flow diagram (if applicable), listing of software with source code, details of settable parameters and their range for BHEL to understand and modify.

Annexure – 13, Page 1 of 5

1. SUBJECT

Oil cooling unit, including:
- Blower housing
- Oil-to-air Heat exchangers, for each traction converter and transformer oil cooling (monobloc design)
- Mounting base
- Blower including 3-phase asynchronous motor, supplied by a static converter and suitable for traction application under Indian ambients

2. TECHNICAL DATAS

2.1. Nominal datas

Weight of the oil cooling unit according to chapter 1, excluding oil: **max.** 840 kg

Oil volume total: 146 l

2.1.1. Heat exchangers

		Converter	Transformer
Heat exchangers			
Make		Behr	Behr
Type of heat exchangers		Monobloc-Design	
Power loss to be dissipated	[kW]	116	120
Air inlet temperature	[°C]	0 ... 47	... 62.8
Air outlet temperature	[°C]	... 62.8	... 76.5
Oil inlet temperature	[°C]	68.2	84.5
Oil outlet temperature	[°C]	64	80
Oil flow	[l/min]	960	1000
Pressure drop oil side	[Pa]	6000	6000
Oil type		Shell Diala DX	Shell Diala DX
Altitude a. s. l.	[m]	0 ... 800	0 ... 800
Humidity nominal	[%]	60	60
Humidity maximal	[%]	100	100

Annexure – 13, Page 2 of 5

2.1.2. Auxiliary motor and blower

		Oil cooler blower Bo'Bo' & Co'Co'
Blower		
Make		Behr
Type of blower		Radial
Air mass flow	[kg/s]	8.8
Pressure drop cooler section, air side	[Pa]	800
Pressure drop inlet/outlet ducts / filter	[Pa]	930
Reserve	[Pa]	50
Static fan pressure	[Pa]	1780
round per minute	[1/min]	2920
P mech. at 47 °C / 160 m	[kW]	23.5
Motor		
Make		Landert
Type		200L55-RH2A
Nominal mech. power	[kW]	25
Power consumption	[kW]	27.5
Nominal voltage	[V]	415 ± 10%
Waveform		Square
Nominal current	[A]	41.5
Starting current	[A]	320
Nominal frequency	[Hz]	50
cos ϕ		0.92
Class of protection		IP 54

The temperature rise $\Delta\vartheta$ limits for the blower motor will be reduced in comparison with the limits given in the IEC standard to take care of the higher ambient temperature in India.

Only insulation system of class F will be acceptable. The permitted temperature rise of the motor windings will be:
$\Delta\vartheta$ = specified temp. rise of class F insulation minus 65 °C
$\Delta\vartheta$ = 155 °C - 65 °C = 90 °C

Vaccum pressure impregnation of the stator winding as and when applicable will be preferred (according to the requirements of Indian Railways). Other requirements of Indian Railways according to enclosure 1.

3.4.4 Cooling concept

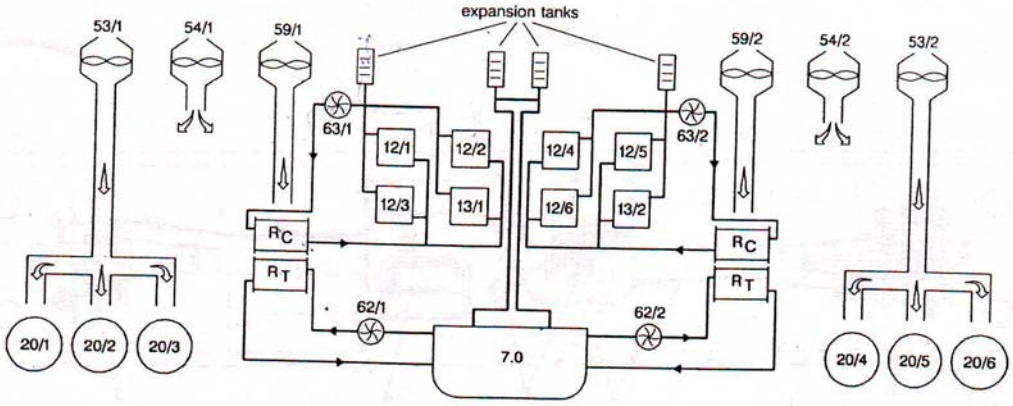


Fig. 3.16 Overview oil circuits

7.0	Main transformer
12	Valve set 2*ZV
13	Valve set ZV+MV
20	Traction motor
53	Traction motor blower
59	Oil cooling unit blower
54	Machine room blower
62	Oil pumps for transformer
63	Oil pumps for converter
R_c	Radiator converter
R_T	Radiator transformer

3.4.4.1 Oil pumps

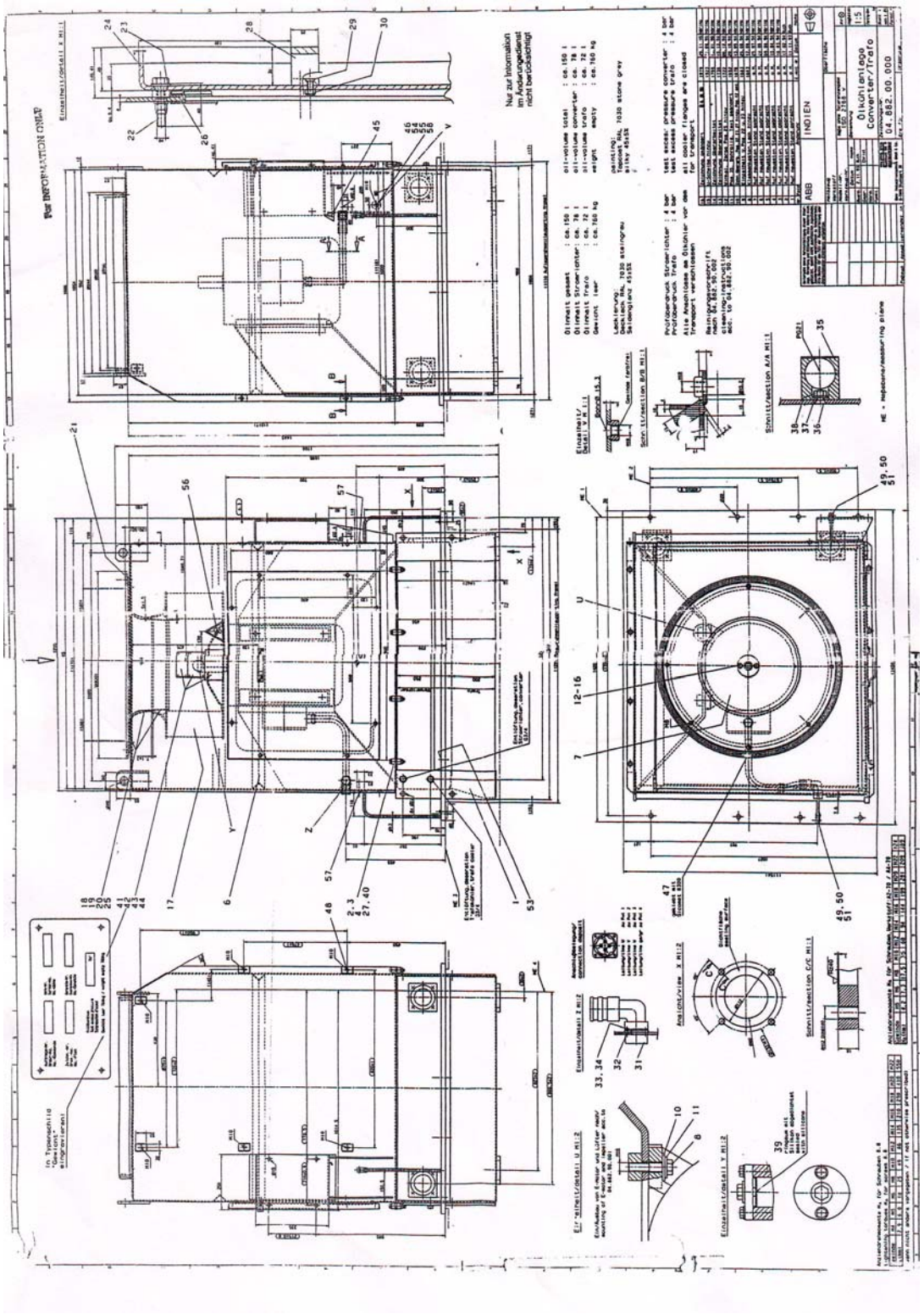
The system comprises:

62	Two oil pumps for the transformer
63	One oil pump on each of the two converters

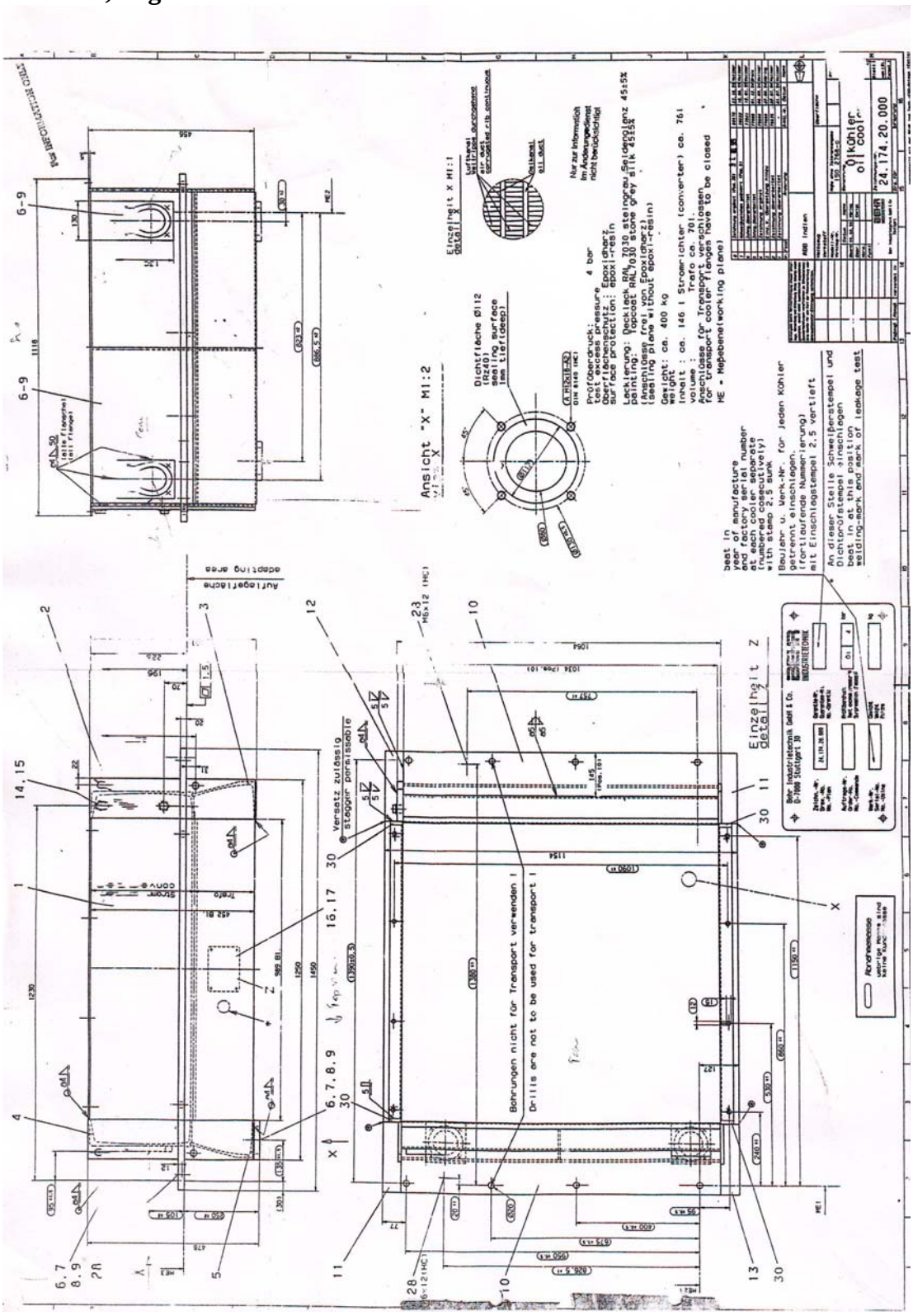
Note:

The oil pumps run continuously as soon as the auxiliary converters are switched on.

Annexure – 13, Page 4 of 5



Annexure – 13, Page 5 of 5



PRICE SCHEDULE

Annexure 5 of ITT

TRACTION CONVERTER & AUX. CONVERTER

PRICE BID FORMAT FOR Traction Converter And Auxiliary Converter Used In WAG-9 / WAP-5 & WAP-7 LOCOMOTIVES

TENDER NO. **DATE OF OPENING……AT ……HRS.**

To,
Sr. Manager (MM),
BHEL - EDN, Bangalore, India

Item no	Description	Unit	Total Qty.	Price per Unit	Total Price	Remarks
				FOB	FOB	
EQUIPMENT - Traction Converter and Auxiliary Converter						
	a) Completely Bulit Unit (CBU)					
1	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	**10**			
2	Cooling system including blowers with motors and casing, oil / air pumps, radiators / heat exchangers for Traction Conv.(item 1)	Set	**10**			
3	IGBT based Auxiliary Converter /Inverter & controls	Set	**10**			
	Sub-Total	**A**				
	b) Semi Knocked Down (SKD)					
4	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	**15**			
5	Cooling system including blowers with motors and casing, oil / air pumps, radiators / heat exchangers for Traction Conv.(item 1)	Set	**15**			
6	IGBT based Auxiliary Converter /Inverter & controls	Set	**15**			
	Sub-Total	**B**				
	c) Completely Knocked Down (CKD) - components					
7	IGBT based Power Converter / Inverter (Axle drive) & controls	Set	**15**			**Refer Annexure 6 of ITT for the explanation of quantity (15).**
8	IGBT based Auxiliary Converter /Inverter & controls	Set	**15**			
	Sub-Total	**C**				
	OTHERS					
SL NO	**Item Description**	**Unit**	**Quantity**			
1	Development charges and documentation charges if any	Set	**1**	-		**To be included in a),b) and c) excluding cooling system.**
2	Supply of Drawings & documents for mechanical modifications, if required.	Set	**1**	-		
3	Training charges at Bidder's place for 300 mandays for design, assembly, testing, commissioning, O&M, trouble-shooting, S/W parameter setting, Root Cause Analysis	Man day	**300**	-		
4	Deputation of experts for 60 days for Erection, Commissioning, Field Trials & Approvals	Man day	**60**	-		
5	Software tools along-with 2 nos. laptop computers.	Set	**1**			**OPTIONAL ITEMS**
6	Special tools and tackles, test equipment including S/W, if any, etc.for assembly,testing, commissioning, trouble	Set	**1**			
7	Any other equipment required (Details to be furnished) *	Set	**1**			
8	Spares for 3 years maintenance during warranty/beyond warranty *	Set	**1**			

	LEVIABLE TAXES and DUTIES	**D**				

Grand Total (A+B+C+D)

While evaluating the Prices for Sl. No. 1, 2 & 3, the Prices will be loaded for a) Longer Delivery Quoted & b) Cost of Withdrawing Deviation

Overall lowest evaluated cost of (A+B+C+D) to BHEL will be considered for selecting the successful bidder.

SIGNATURE OF TENDERER

NOTES

1. *Shall not be considered for evaluation of offers.
2. No change in the Format is permissible and the bidders are required to quote in this Format only.
3. Bidder has to necessarily quote for Optional Items, however this will not be taken for evaluation
4. Prices indicated in FOB column to be mentioned both in figures & words.
5. The tender documents should be read thoroughly before submitting the prices.
6. Itemised Prices for Traction Converter and Auxiliary Converter to be separately indicated for CBU, SKD & CKD Options
7. Bidder not to include taxes , duties, levies etc. payable in Indian Territory which shall be borne by BHEL
8. Technology transfer documents shall be supplied during the delivery and manufacture of first 20 sets as indicated in annexure 5 of ITT. **This is mandatory condition without which the bid will be considered unresponsive and rejected without any evaluation.** The exact phasing shall be decided with the successful bidder.
9. **CBU - Completely built unit**, manufactured, assembled, tested at bidders premises. trail
10. **SKD - Semi knocked down units**. All sub assemblies including hardware and consumables to be supplied for the final assembly and testing of the equipment at purchasers premises.
11. **CKD - Completely knocked down units**. All components including hardware and consumables to be supplied for the assembly & testng of sub-assembly, final assembly and testing of the equipment at purchasers premises. The Phase wise indeginisation will be attempted at this stage. The tentative Phasing is indicated in **Annexure - 6 of ITT.** While calculating the quantity indicated for item 7 & 8, the Bidders contribution in each Phase (in Percentage) and corressponding Quantity are multiplied and summed up.

SIGNATURE OF TENDERER

Annexure 6/ITT

Details of localisation for IGBT based propulsion system

1	2	3	4	5	6	7
Description	**5 Sets of TC & 2 Sets of AC**	**6 -10 Sets of TC and 3 - 10 Sets of AC**	**11 - 25 Sets of TC and AC**	**26 - 40 Sets of TC and AC**	**41-70 Sets of TC and AC**	**71-100 Sets of TC and AC**
Time frame	**2009-10**	**2011-12**	**2012-13**	**2013-14**	**2013-14**	**2014-15**
Quantity - Traction Converter (TC)	**5**	**5**	**15**	**15**	**30**	**30**
Quantity - Auxiliary Converter (AC)	**2**	**8**	**15**	**15**	**30**	**30**
%age of Bidder Contribution				**30%**	**20%**	**15%**
Traction converter & controls	CBU	CBU	SKD	**Please refer to Annexure 5 / ITT**		
Auxiliary converter & controls	CBU	CBU	SKD			

NOTES:

a) The TC and AC quantity indicated in Columns 3 to 7 is tentative and may change.

b) Scope of supply for prototype equipments shall consist of design of equipment; Modifications in existing mechanical design, if any; Design approval from RDSO; Manufacturing of equipment; Equipment testing; System testing at bidder's works; Assistance in erection & commissioning of equipment on loco at CLW; Association in field trials; Modifications, if any and Acceptance by IR.

c) Scope of supply for CBUs shall consist of Manufacturing & testing of equipment; Assistance in erection & commissioning at CLW.

d) To achieve the localisation the transfer of Information shall be as per Annexure 12 of Technical Specification

e) Scope of supply of SKD units shall consist of Manufacturing & supply of major sub-assemblies as defined in attached annexures 1.

f) The quantity for CKD Components as indicated in Annexure -5 of ITT is arrived as follows: The quantity in Columns 5 - 7 are multiplied by Respective % age of Bidder portion, (i.e. 0.30*15 + 0.20*30 + 0.15*30 = 15) .