


# REQUEST FOR QUOTATION

	<b>BHARAT HEAVY ELECTRICALS LIMITED</b> Electronics Division PB No. 2606, Mysore Road Bangalore - 560026 INDIA	RFQ NUMBER: KJHM900050  RFQ DATE : 24.SEP.2008	Due Date <b>20.OCT.2008</b> Time: 13:00 HRS  VENUE : <b>NEW ENGG. BLDG</b>
MMI:PU:RF:003			

	(for all correspondence) Purchase Executive : JAGADEESH K Phone : 080-26742395 Fax : 00918026744227 E-mail: jagadeesh@bheledn.co.in
--	---


Please submit your lowest quotation subject to our terms and conditions attached for the material mentioned below. The quotation must be enclosed in a sealed envelope / Fax superscribed with RFQ no.and due date, should reach us on or before the due date by **13.00** hours IST and will be opened on the same day

1. TENDER / OFFER SHALL BE SUBMITTED IN TWO PARTS.
2. QUOTATIONS MAY BE SUBMITTED BY OEM OR THEIR AUTHORISED DEALERS.
3. VENDOR IS EXPECTED TO HAVE ESTABLISHED SALES,SERVICE AND SUPPORT NETWORK PREFERABLY, IN INDIA. A LIST OF THE SAME NEEDS TO BE ENCLOSED WITH THE OFFER.
4. A LIST OF REFERENCES INCLUDING CUTSTOMER#S DETAILS LIKE CONTACT, MACHINES INSTALLED, DATE OF INSTALLATION IN INDIA AND ABROAD SHALL BE SUBMITTED THAT ESTABLISHES THE SATISFACTORY PERFORMANCE OF SUPPLIER'S EQUIPMENT FOR AT LEAST THREE YEARS.
5. VENDOR IS ADVISED TO GO THROUGH THE GENERAL TERMS AND CONDITIONS DOCUMENT CPD-00 ENCLOSED WITH RFQ.
6. BHEL RESERVES THE RIGHT TO RESORT TO REVERSE AUCTION BEFORE THE PRICE BID OPENING.
7. VENDOR HAS TO CONFORM TO ALL THE CLAUSES LISTED IN THE TECHNO-COMMERCIAL TERMS (ANNEXURE-B OF DOCUMENT CPD-00). DEVIATIONS, IF ANY, TO BE HIGHLIGHTED AND BROUGHT OUT CLEARLY.
8. VENDOR HAS TO CONFORM TO ALL THE CLAUSES IN THE PURCHASE SPECIFICATIONS.
9. DELIVERY REQUIRED: WITHIN 16 WEEKS FROM THE DATE OF PURCHASE ORDER.
10. TERMS OF PAYMENT: 75% WITHIN 30 DAYS OF RECEIPT OF MATERIAL, 15 % AFTER INSTALLATION AND COMMISSIONING AND THE REST 10% AGAINST SUBMISSION OF PBG.

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	CU9095003092 CONVERTER TRANSFORMER 1500KVA CONVERTER TRANSFORMER 1500KVA,415/3400-3400V, 3 PH AS PER SPEC: PS-445-065  DRW PS445065 00	1	NO	1	09.JAN.2009
2	CU9095003100 CONVERTER TRANSFORMER 1600KVA CONVERTER TRANSFORMER 1600KVA,415/2300V , 3 PH AS PER SPEC: PS-445-062  DRW PS445062 00	1	NO	1	09.JAN.2009
3	CU9095003119 CONVERTER TRANSFORMER 500KVA CONVERTER TRANSFORMER 500KVA,11000/415V, 3 PH	1	NO	1	09.JAN.2009

For and On behalf of BHEL.

## REQUEST FOR QUOTATION

	<b>BHARAT HEAVY ELECTRICALS LIMITED</b> Electronics Division PB No. 2606, Mysore Road Bangalore - 560026 INDIA	RFQ NUMBER: KJHM900050  RFQ DATE : 24.SEP.2008	Due Date <b>20.OCT.2008</b> Time: 13:00 HRS  VENUE : <b>NEW ENGG. BLDG</b>
MMI:PU:RF:003			

	(for all correspondence) Purchase Executive : JAGADEESH K Phone : 080-26742395 Fax : 00918026744227 E-mail: jagadeesh@bheledn.co.in
--	---

Please submit your lowest quotation subject to our terms and conditions attached for the material mentioned below. The quotation must be enclosed in a sealed envelope / Fax superscribed with RFQ no. and due date, should reach us on or before the due date by **13.00** hours IST and will be opened on the same day

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
	AS PER SPEC: PS-445-063  DRW PS445063 00				
4	CU9095003135 CONVERTER TRANSFORMER 100KVA CONVERTER TRANSFORMER 100KVA, 415/11000V, 3 PH AS PER SPEC: PS-445-064  DRW PS445064 00	1	NO	1	09.JAN.2009

Total Number of Items - 4

Please note that the tender will be opened in the presence of the bidders or his authorised representatives (maximum two per organisation) who choose to be present with authorisation letters. Refer annexure for the terms and conditions.  
 Preference will be given to vendors who accepts our standard payment terms i.e.100% payment - 30 days after receipt of material at our works subject to acceptance.  
 Please specify Terms of delivery, Excise duty, sales tax, Ex-BHEL, Ex-works surcharge, Insurance,P&F, Freight and other taxes very clearly .

- i). This is only RFQ not an order.
- ii). In all correspondence quote RFQ No. & due date.
- iii). In Quotation BHEL material code / RFQ Sl. No. should be mentioned clearly.
- iv). Quotation Envelope / Fax not superscribed with RFQ No. and due date is liable for rejection.
- v). Quotation should remain valid for a minimum period of 90 days from due date.
- vi). In case of non-receipt of Quotation or regret letter for 3 consecutive RFQs you are liable to be removed from our vendors list.
- vii). All Prices should be written in words and numbers.
- viii). Excise Chapter Heading should be mentioned for all items where VAT is applicable .

For and On behalf of BHEL.



A4 - 10

## PURCHASE SPECIFICATION

GROUP : TRACTION ENGINEERING

P.S NO. : PS/445/062

REV. NO : 00

PAGE 01 OF 18

### SPECIFICATION FOR CONVERTER TRANSFORMER FOR LOAD COMMUTATED INVERTER

LOCATION : CENTRE OF EXCELLENCE(COE), BHEL/EDN, BANGALORE  
APPLICATION : USED AT THE INPUT OF LOAD COMMUTATED INVERTER

1. Quantity : 1 no.
2. Type of cooling : ONAN. Mineral oil filled
3. Rating (at all taps) : 1600 KVA Continuous
4. Number of phases : 3
5. Voltages  
Primary (L-L) : 415 Volts  $\pm$  10% (Delta connection)  
(LV side)  
Secondary (L-L) : 2300 volts (Star connection)  
(HV side)
6. Frequency : 50Hz  $\pm$  5%
7. Combined volt & freq. variation : 10% (Absolute sum)
8. Number of winding : 2 - Both windings uniformly insulated. BIL Level 2 as per IS2026
9. Vector group : YNd1 (Primary to Secondary DYN11)  
With HT Neutral terminal as 4<sup>th</sup> terminal in HV Cable Box
10. Impedance / Tolerance : 12% on principal tap ( Minimum)  
Tolerance + 10 % - 0 %
- 10a. Voltage/ freq ratio : Shall be designed for 1.1 continuous.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

REVISION 00

APPROVED BY S K .IYENGAR

PREPARED BY  
V. SESHADRI

ISSUED BY  
TRACTION

DATE  
04/09/08



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 02 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

11. Installation : Outdoor  
(Under direct sunlight)
12. Ambient temp. : 50 Degree C
13. Duty : Rectifier duty.
14. Temperature rise
- (a) Design ambient temp. : 50 Degree C.
- (b) Temp. rise of top of oil by thermometer : 50 Degree C.
- (c) Temp. rise of wdg. by resistance method : 55 Degree C
15. Relative Humidity : 100 %
16. Short Ckt. level at 415V : 40 KA RMS
17. Suitability to withstand switching surges : Not Applicable. Switching on LV side with Air Circuit Breaker
18. a) Material of winding : Copper – Electrolytic Grade
- b) Core : Not to exceed  $1.7 \text{ Wb/m}^2$  at any tap position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. The laminated core shall be of high grade cold rolled grain oriented silicon steel.
- c) Tank : Tank shall be of welded construction and fabricated from tested low carbon steel. It shall be designed for a continuous internal pressure of 0.35 Kg/sq.cm over normal hydrostatic pressure of oil. The tank cover shall be sloped to prevent retention of rain water. All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket, in between for complete oil tightness. Bi – directional rollers, jacking pads( four nos) , lifting lugs shall be provided.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 03 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- d) Hardware : All nuts and bolts exposed to weather shall be hot dip galvanised or cadmium plated or zinc passivated steel.
19. Noise : Not to exceed values specified in NEMA TR-1.
20. Insulating oil : Fresh oil (before pouring into transformer) should be as per IS 335, without inhibitor. 10% extra oil shall be supplied for topping in non returnable containers in sealed drums.
21. Terminal arrangement : Suitable for termination of XLPE cable with Raychem type heat shrinkable terminating kits on HT side; 6 mm thick Aluminum blank (undrilled) gland plates to be supplied with H.T., L.T. and Mar-shalling boxes. Bushings of Porcelain conforming to IS 2099 & IS 3347. The minimum length between cable gland plate and cable lug to be 550 mm for both H.V. and L.T. side cable boxes. Terminal marking shall be as per IS 2026.
22. Tap changer : On HV winding – OFF circuit tap changer with padlocking facility as per IS 2026 with warning plate " SWITCH TO BE OPERATED WITH TRANSFORMER DE-ENERGISED"
23. Taps : Taps +/- 5 % in steps of +/- 2.5 %
24. Painting (Transformer and accessories) : Epoxy.
25. Shade : 631 of IS 5



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 04 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

26. Fittings and accessories : As per Annexure-1
27. Standards : IS 2026
28. Testing (Routine Tests) : As per IS 2026 with latest amendments
29. Quality plan : Supplier should submit his standard Quality Plan for approval.
30. Testing ( Type Tests) : Temperature Rise test on Transformer as per IS2026 with latest amendments
31. Vendor List : Vendor List for bought out Items to be submitted for . BHEL approval.
32. No load loss & Load Loss : Guaranteed maximum values without any positive tolerance shall be given with the offer. (See page 11 of this specification) An amount of Rs. 15000/- per KW of differential copper loss and Rs.60,000/- per KW of differential iron loss will be levied on the manufacturer, if these losses exceed the guaranteed losses quoted.
33. List of spares : Complete set of gaskets - 2 Sets
- Oil temp. indicator ( Dial Type) - 1 No with alarm & trip contacts
- Winding temp. indicator ( Dial Type) - 1 No with alarm & trip contacts



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 05 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- HV bushing with metal parts and gaskets. - 3 Nos
- LV bushing with metal parts and gaskets. - 3 Nos
- Tap changer assembly with contacts - 1 set
- Magnetic oil level gauge - 1 No
- Buchholz relay - 1 No
- Diaphragm of explosion vent - 3 Nos.
- Silica Gel Charge - 2 charges
- Set of valves (1 no. of each size) – 1 set
- Remote WTI Sensor (4-20mA) - 1 No.
- Remote OTI Sensor (4-20mA) - 1 No.

34. Information flow

- (A) The DATA SHEETS shall be completed fully and all guaranteed figures must be without any tolerance.  
Supplier must very clearly mention if any deviation is taken on the specification.
- (B) Following information shall be submitted after placement of order :
  - (a) All preliminary drawings for approval.
    - (i) 4 prints



A4 - 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 06 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- (b) All final drgs after approval
- (i) 6 prints
- (ii) Drawings in CD-ROM.

- (c) Test certificates and guarantee certificates
- (i) 3 copies

- (d) Instruction and maintenance Manuals - 5 copies

**35. DATA SHEET**

: DATA SHEET (Annexure – 3) is enclosed with this specification. The same is to be filled up and submitted alongwith the technical offer.

**36. INFORMATION REQD WITH OFFER**

- (i) Filled up data sheet
- (ii) Deviations to this specification. If there are no deviations, supplier must mention the same explicitly in their technical offer.
- (iii) Vendor List for all major bought-out items

**Note :** The test charges for Temperature Rise test must be mentioned in the price bid. However, a confirmation to that effect must be contained in the technical offer.

Unpriced copy of price bid must be enclosed in Technical offer.



A4 - 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 07 OF 18

**ANNEXURE - 1**

All accessories shall be provided confirming to IS 3639.  
The following fittings and accessories shall be provided:

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
01.	Oil filling hole with cover	1
02.	Conservator with sump & drain valve with plug/cover plate. The Breather shall be mounted at a height less than 1600 mm from the ground.	1
03.	a) Magnetic Oil level gauge(Dial type) with minimum and maximum filling level markings. It should have two independent electrically insulated low level alarm contacts suitable for 220 V DC.The oil level at 30 deg C shall be marked on the gauge. Contact suitable for 220 V DC.	1
	b) Prismatic oil level gauge	1
04.	Thermometer pockets	1
05.	Air release plug on tank cover	1
06.	Lifting lugs	1 SET
07.	Top filter valve	1
08.	Dehydrating breather with Silicagel and oil seal	1
09.	Off circuit tap changing switch on tank cover with tap position indicator, locks and handle.	1
10.	Rating and terminal marking stainless steel/anodised aluminum plate, with details etched in MKS & SI units.	1

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 08 OF 18

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
11.	Earthing terminals without lugs suitable for connecting 50x6 mm galvanized mild steel flat.	2
12.	Diagram plate	1
13.	Drain cum bottom filter valve	1
14.	Base channel with towing holes/lugs	2
15.	Double diaphragm explosion vent with sight glasses and equaliser pipe connection to conservator.	1
16.	Four Jacking Pads to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	1 SET
17.	Manufacturer's name plate (stainless steel/ Anodised Aluminium)	1
18.	Bi-directional rollers	1 SET
19.	Detachable radiator with bottom drain plug, top air release plug and top & bottom shut off valve.	1 SET
20.	Buchholz relay should be of double float type with testing & sampling cocks, alarm and trip contacts and one isolating valve on conservator side	1 SET
21.	150mm dial type oil temp. Indicator and winding temp. Indicators with max. pointer with alarm and trip contacts. Contacts suitable for 220V DC. Indicator accuracy $\pm 2\%$ . Alarm and trip points to be adjustable. Full scale temp. 240 deg C. Least count 2 deg C. Oil / Winding temp. Indicators should be provided with resetting device.	1 SET
22.	Cable glands & lugs Cable sizes shall be informed at the time of drawing finalisation. Cable lugs shall be of tinned copper for crimping to stranded aluminium conductor cable. Cable glands will be of double compression type.	1 SET

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 09 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
23.	Marshalling box (protection class IP55 and IS 2147) epoxy painted. Should be vermin, weather, dust proof. Terminal connector of control cable should be DOWELL make or equivalent. 20% extra spare terminals reqd. All TBs to be complete with insulating barriers, clip on type terminals suitable to 2.5 sq mm stranded copper wire. The marshaling box and temperature indicators shall not be mounted at a height greater than 1600 mm from the ground level. The box shall be tank mounted with sloping roof. All incoming cables shall enter from bottom. Sheet steel to be 1.6 mm thick. Thermostatically Controlled space heaters shall be provided.	1 No
24.	Inspection openings on tank with handles	2 Nos
25.	Remote WTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.
26.	Remote OTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.

NOTE :1) Contacts of all temp indicators, Buchholz relays and auxiliary devices shall be suitable for 220 V dc supply. All alarm and trip contacts shall also be suitable for 220 V dc circuits. External power supply will not be provided.

2) Nuts and bolts exposed to weather to be hot dipped galvanized or cadmium plated or zinc passivated steel.

3) Control wiring to be done with 1100 V grade PVC wire, 2.5 mm stranded copper wire.

4) Cable glands and lugs shall be supplied loose alongwith transformer. See pt 22.  
Cable glands will be double compression nickel plated brass.  
Cable lugs will be installed with fixing hardware in the cable box.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 10 OF 18

**DATA SHEET (ANNEXURE –2)**

- 1) Manufacturer's Name and address :
- 2) Service Class / KVA rating :
- 3) Rated Voltage
  - a) HV Winding KV :
  - b) LV Winding KV :
- 4) Rated frequency :
- 5) Number of phases :
- 6) Connections
  - a) HV Winding :
  - b) LV Winding :
- 7) Connection symbol :
- 8) Type of cooling :
- 9) Tap changing equipment
  - a) Manufacturer :
  - b) Type :
  - c) Rated Voltage and Current :
  - c) No of steps :
  - d) Tap range % to % :
- 10) Guaranteed positive sequence impedance at 75 deg C with 100% rating
  - a) Principal tap :
  - b) Maximum tap (Approx) :
  - c) Minimum tap (Approx) :

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 11 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 11) Temp. rise over an ambient of 50 deg C
- a) Top oil deg C :
  - b) Winding (by resistance measurement method deg C ) :
- 12) Guaranteed losses at rated voltage on principal tap and at rated current rated frequency \*
- a) No load loss KW : (Max)
  - b) Copper loss at full load and 75 deg C KW : (Max)
- 13) Withstand time for three phase short circuit at terminals (sec.) :
- 14) Insulation level
- a) Separate source power frequency voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :
  - b) Induced over voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
  - c) Full wave lightning impulse withstand
    - i) HV Winding (KV) :
    - ii) LV Winding (KV) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :

**\* NOTE : LOSS FIGURES TO BE GIVEN WITHOUT ANY POSITIVE TOLERANCE. PLEASE SEE POINT 32 (PAGE 04) OF THIS SPECIFICATN.**



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 12 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

d) Switch impulse withstand voltage

i) HV Winding (KV) :

ii) LV Winding (KV) :

iii) HV Bushing :

15) Regulation at full load at 75 deg C

a) At unity power factor (percent) :

b) At 0.8 power factor (percent) :

16) Terminal arrangement

a) High Voltage :

b) Low Voltage :

c) HV Neutral :

17) Over excitation withstand time (sec)

a) 120% :

b) 150% :

18) Bushing

a) High Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 13 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

b) Low Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

c) Neutral (shall be available in HV Cable Box)

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

19) Proposed method of transformer shipment :

20) Total quantity of oil (litres) required for first filling :

21) Is vacuum filling required, if so, state absolute pressure :

22) Efficiency at 75 deg C at unity power factor

a) At full load ( percent ) :

b) At 3/4 full load (percent) :

c) At 1/2 full load (percent) :

23) Approximate dimensions

a) Tank enclosure (mm) :  
L x B x H

b) Overall L x B x H (mm)

24) Untanking height (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 14 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 25) Approximate weight (kg)
- a) Core
  - b) Winding – HV and LV
  - c) Insulation :
  - d) Tank – Enclosure and Cover :
  - e) Fittings :
  - f) Oil
  - g) Untanking weight :
  - g) Total weight :
- 26) Despatch details (Kg)
- a) Approximate mass of heaviest package (Kg) :
  - b) Approximate dimensions of largest package
    - i) Length (mm) :
    - ii) Breadth (mm) :
    - iii) Height (mm) :
  - c) Total Shipping weight :
  - d) Number of packages
  - e) Parts detached for transport like conservator, radiator, pipes, explosion vent etc.
- 27) Reference standards :
- 28) Type of Construction (Core/Shell) :
- 29) Thermal time constant (Hours) :
- 30) Magnetizing inrush current (Amps) :
- 31) No load current at rated frequency and at (Approx)
- i) 90% voltage (Amps) :
  - ii) 100% voltage (Amps) :
  - iii) 110% voltage (Amps) :
- 32) Power factor of no load current :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 15 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 33) Zero sequence impedance at principal tap :
- 34) Capacitance between winding and to earth (micro farads) :
- 35) Percentage reactance at rated current and frequency and at
  - i) Principal tap :
  - ii) Maximum tap :
  - iii) Minimum tap :
- 36) Radiator
  - i) Overall dimensions lxbxh (mm) :
  - ii) Total weight with oil (Kg) :
  - iii) Total weight without oil (Kg) :
  - iv) Type of mounting :
  - v) Thickness of Radiator tube(approx) radiator sheet steel (approx) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 16 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 37) Size of filter hose (mm) :
- 38) Core :
- a) Form of core :
- b) Net core area (mm<sup>2</sup>) :
- c) Type of joint between core and yoke :
- d) Thickness of stamping (mm) :
- e) Percentage silicon content (percent) :
- f) Maximum flux density in core at rated frequency and at
- i) 90% voltage (Wb/m<sup>2</sup>) :
- ii) 100% voltage (Wb/m<sup>2</sup>) :
- iii) 110% voltage (Wb/m<sup>2</sup>) :
- g) Type of core binding :
- 39) Winding
- a) Type of winding
- i) HV :
- ii) LV :
- b) Current density at rated load
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- c) Conductor area
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- d) Maximum current density under short circuit
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 17 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

40) Clearance

a) Minimum clearance between phase

i) In oil (mm) :

ii) In air (mm) :

b) Minimum clearance of HV winding to tank/enclosure (in oil, if applicable),(mm) :

c) Minimum clearance of HV winding to earth (In oil, if applicable),(mm) :

d) Clearance between core and coil (mm) :

e) Clearance between coils (mm) :

41) Tank/enclosure details

i) Side (mm) :

ii) Bottom (mm) :

iii) Cover (mm) :

42) Insulation levels

i) Power Frequency : HV 10 kV LV 3 kV

ii) Lightning Impulse : 40 kV 10 kV

43) Bushings

i) Type : HV Porcelain LV Porcelain

ii) Rated Voltage : 3.6 kV 3.0 kV

iii) Lightning Impulse : 40 kV 10 kV

iv) Creepage distance : 75mm 25mm

v) Power Frequency : 10 kV 3.0 kV



A4 – 11

**PURCHASE SPECIFICATION**

**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/062

REV. NO : 00

PAGE 18 OF 18

44) Magnetic Oil Level Gauge :  
(Dial type) Size

45) List of deviations (if any) : YES / NO  
enclosed with offer. If no deviations please mention  
the same here.

NOTE : The neutral on HV Side will be the 4<sup>th</sup> terminal on the HT Cable Box. Neutral will be kept floating in actual service.  
Neutral to be insulated to full line voltage with adequate clearances and creepages as for Line Terminals.

**Pre Qualification Criteria:**

1. The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers along with an authorization letter can submit offers. An authorized Representative/Dealer cannot quote for the same equipment from more than one OEM.
2. Offer shall be for a new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.
3. The vendor should have the capability to design Transformers for Rectifier duty. He should have already supplied and installed 3 nos. of similar rating transformers in India during the past 5 years and these must be operating satisfactorily for at least past one year. The details of the customers with contact details, transformers installed, date of installations etc. to be provided.
4. The vendor or their authorized service representatives shall have trained engineers for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for our installations.
5. The vendor shall be in a position to undertake AMC or provide service support for the equipment supplied, after the expiry of the warranty/ guarantee period either directly or through a service representative.
6. The vendor shall furnish a comprehensive warranty for at least 12 months from the date of commissioning.

**Note:**

1. Pre qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre qualification criteria are mandatory requirements and the technical bids will be evaluated only when the Pre Qualification criteria are met.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 - 12

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

P/PAGE 00 OF 18

**REVISION HISTORY SHEET**

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in any way detrimental to the interest of the company.

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	04.09.08	FIRST ISSUE	-----	-----	-----

REVISIONS 00

APPROVED BY

S.K.IYENGAR

PREPARED BY

*V. Seshadri*  
V SESHADRI

ISSUED BY

TRACTION

DATE

04/09/08



A4 - 10

### PURCHASE SPECIFICATION

GROUP : TRACTION ENGINEERING

P.S NO. : PS/445/063

REV. NO : 00

PAGE 01 OF 18

### SPECIFICATION FOR CONVERTER TRANSFORMER FOR COE TEST FACILITY

LOCATION : CENTRE OF EXCELLENCE(COE), BHEL/EDN, BANGALORE  
APPLICATION : USED AT THE INPUT OF COE TEST FACILITY – LCI, IGBT  
VFD, AC LOCO, DIESEL LOCO, AND EMU TESTING

- 1. Quantity : 1 no.
- 2. Type of cooling : ONAN. Mineral oil filled
- 3. Rating (at all taps) : 500 KVA Continuous
- 4. Number of phases : 3
- 5. Voltages
  - Secondary (L-L) (LV side) : 415 Volts ± 10% (Star connection)
  - Primary (L-L) (HV side) : 11000 volts (Delta connection)
- 6. Frequency : 50Hz ± 5%
- 7. Combined volt & freq. variation : 10% (Absolute sum)
- 8. Number of winding : 2 – Both windings uniformly insulated. BIL Level 2 as per IS2026
- 9. Vector group : Dyn11  
With LT Neutral terminal as 4<sup>th</sup> terminal in LV Cable Box
- 10. Impedance / Tolerance : 8% on principal tap ( Minimum)  
Tolerance + 10 % - 0 %
- 10a. Voltage/ freq ratio : Shall be designed for 1.1 continuous.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in any way detrimental to the interest of the company.

REVISION 00

APPROVED BY S K .IYENGAR

PREPARED BY  
*V. Seshadri*  
V SESHADRI

ISSUED BY  
TRACTION

DATE  
04/09/08



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 02 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

11. Installation : Outdoor  
(Under direct sunlight)
12. Ambient temp. : 50 Degree C
13. Duty : Rectifier duty.
14. Temperature rise
- (a) Design ambient temp. : 50 Degree C.
- (b) Temp. rise of top of oil by thermometer : 50 Degree C.
- (c) Temp. rise of wdg. by resistance method : 55 Degree C
15. Relative Humidity : 100 %
16. Short Ckt. level at 415V : 40 KA RMS
17. Suitability to withstand switching surges – VCB on HV side : Required
18. a) Material of winding : Copper – Electrolytic Grade
- b) Core : Not to exceed  $1.7 \text{ Wb/m}^2$  at any tap position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. The laminated core shall be of high grade cold rolled grain oriented silicon steel.
- c) Tank : Tank shall be of welded construction and fabricated from tested low carbon steel. It shall be designed for a continuous internal pressure of 0.35 Kg/sq.cm over normal hydrostatic pressure of oil. The tank cover shall be sloped to prevent retention of rain water. All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket, in between for complete oil tightness. Bi – directional rollers, jacking pads( four nos) , lifting lugs shall be provided.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 03 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- d) Hardware : All nuts and bolts exposed to weather shall be hot dip galvanised or cadmium plated or zinc passivated steel.
19. Noise : Not to exceed values specified in NEMA TR-1.
20. Insulating oil : Fresh oil (before pouring into transformer) should be as per IS 335, without inhibitor. 10% extra oil shall be supplied for topping in non returnable containers in sealed drums.
21. Terminal arrangement : Suitable for termination of XLPE cable with Raychem type heat shrinkable terminating kits on HT side; 6 mm thick Aluminum blank (undrilled) gland plates to be supplied with H.T., L.T. and Mar-shalling boxes. Bushings of Porcelain conforming to IS 2099 & IS 3347. The minimum length between cable gland plate and cable lug to be 550 mm for both H.V. and L.T. side cable boxes. Terminal marking shall be as per IS 2026.
22. Tap changer : On HV winding – OFF circuit tap changer with padlocking facility as per IS 2026 with warning plate " SWITCH TO BE OPERATED WITH TRANSFORMER DE-ENERGISED"
23. Taps : Taps +/- 5 % in steps of +/- 2.5 %
24. Painting (Transformer and accessories) : Epoxy.
25. Shade : 631 of IS 5



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 04 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 26. Fittings and accessories : As per Annexure-1
- 27. Standards : IS 2026
- 28. Testing (Routine Tests) : As per IS 2026 with latest amendments
- 29. Quality plan : Supplier should submit his standard Quality Plan for approval.
- 30. Testing ( Type Tests) : Temperature Rise test on Transformer as per IS2026 with latest amendments
- 31. Vendor List : Vendor List for bought out Items to be submitted for . BHEL approval.
- 32. No load loss & Load Loss : Guaranteed maximum values without any positive tolerance shall be given with the offer. (See page 11 of this specification) An amount of Rs. 15000/- per KW of differential copper loss and Rs.60,000/- per KW of differential iron loss will be levied on the manufacturer, if these losses exceed the guaranteed losses quoted.
- 33. List of spares : Complete set of gaskets - 2 Sets  
Oil temp. indicator ( Dial Type) with alarm & trip contacts - 1 No  
Winding temp. indicator ( Dial Type) with alarm & trip contacts - 1 No



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 05 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- HV bushing with metal parts and gaskets. - 3 Nos
- LV bushing with metal parts and gaskets. - 3 Nos
- Tap changer assembly with contacts - 1 set
- Magnetic oil level gauge - 1 No
- Buchholz relay - 1 No
- Diaphragm of explosion vent - 3 Nos.
- Silica Gel Charge - 2 charges
- Set of valves (1 no. of each size) – 1 set
- Remote WTI Sensor (4-20mA) - 1 No.
- Remote OTI Sensor (4-20mA) - 1 No.

34. Information flow

- (A) The DATA SHEETS shall be completed fully and all guaranteed figures must be without any tolerance.  
Supplier must very clearly mention if any deviation is taken on the specification.
- (B) Following information shall be submitted after placement of order :
  - (a) All preliminary drawings for approval.
    - (i) 4 prints



A4 - 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 06 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- (b) All final drgs after approval
- (i) 6 prints
- (ii) Drawings in CD-ROM.

- (c) Test certificates and guarantee certificates
- (i) 3 copies

- (d) Instruction and maintenance Manuals - 5 copies

35. DATA SHEET

: DATA SHEET (Annexure – 3) is enclosed with this specification. The same is to be filled up and submitted alongwith the technical offer.

36. INFORMATION REQD WITH OFFER

- (i) Filled up data sheet
- (ii) Deviations to this specification. If there are no deviations, supplier must mention the same explicitly in their technical offer.
- (iii) Vendor List for all major bought-out items

Note : The test charges for Temperature Rise test must be mentioned in the price bid. However, a confirmation to that effect must be contained in the technical offer.

Unpriced copy of price bid must be enclosed in Technical offer.



A4 - 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 07 OF 18

**ANNEXURE - 1**

All accessories shall be provided confirming to IS 3639.  
The following fittings and accessories shall be provided:

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
01.	Oil filling hole with cover	1
02.	Conservator with sump & drain valve with plug/cover plate. The Breather shall be mounted at a height less than 1600 mm from the ground.	1
03.	a) Magnetic Oil level gauge(Dial type) with minimum and maximum filling level markings. It should have two independent electrically insulated low level alarm contacts suitable for 220 V DC.The oil level at 30 deg C shall be marked on the gauge. Contact suitable for 220 V DC.	1
	b) Prismatic oil level gauge	1
04.	Thermometer pockets	1
05.	Air release plug on tank cover	1
06.	Lifting lugs	1 SET
07.	Top filter valve	1
08.	Dehydrating breather with Silicagel and oil seal	1
09.	Off circuit tap changing switch on tank cover with tap position indicator, locks and handle.	1
10.	Rating and terminal marking stainless steel/anodised aluminum plate, with details etched in MKS & SI units.	1

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 08 OF 18

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
11.	Earthing terminals without lugs suitable for connecting 50x6 mm galvanized mild steel flat.	2
12.	Diagram plate	1
13.	Drain cum bottom filter valve	1
14.	Base channel with towing holes/lugs	2
15.	Double diaphragm explosion vent with sight glasses and equaliser pipe connection to conservator.	1
16.	Four Jacking Pads to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	1 SET
17.	Manufacturer's name plate (stainless steel/ Anodised Aluminium)	1
18.	Bi-directional rollers	1 SET
19.	Detachable radiator with bottom drain plug, top air release plug and top & bottom shut off valve.	1 SET
20.	Buchholz relay should be of double float type with testing & sampling cocks, alarm and trip contacts and one isolating valve on conservator side	1 SET
21.	150mm dial type oil temp. Indicator and winding temp. Indicators with max. pointer with alarm and trip contacts. Contacts suitable for 220V DC. Indicator accuracy $\pm 2\%$ . Alarm and trip points to be adjustable. Full scale temp. 240 deg C. Least count 2 deg C. Oil / Winding temp. Indicators should be provided with resetting device.	1 SET
22.	Cable glands & lugs Cable sizes shall be informed at the time of drawing finalisation. Cable lugs shall be of tinned copper for crimping to stranded aluminium conductor cable. Cable glands will be of double compression type.	1 SET

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 09 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
23.	Marshaling box (protection class IP55 and IS 2147) epoxy painted. Should be vermin, weather, dust proof. Terminal connector of control cable should be DOWELL make or equivalent. 20% extra spare terminals reqd. All TBs to be complete with insulating barriers, clip on type terminals suitable to 2.5 sq mm stranded copper wire. The marshaling box and temperature indicators shall not be mounted at a height greater than 1600 mm from the ground level. The box shall be tank mounted with sloping roof. All incoming cables shall enter from bottom. Sheet steel to be 1.6 mm thick. Thermostatically Controlled space heaters shall be provided.	1 No
24.	Inspection openings on tank with handles	2 Nos
25.	Remote WTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.
26.	Remote OTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.

NOTE :1) Contacts of all temp indicators, Buchholz relays and auxiliary devices shall be suitable for 220 V dc supply. All alarm and trip contacts shall also be suitable for 220 V dc circuits. External power supply will not be provided.

2) Nuts and bolts exposed to weather to be hot dipped galvanized or cadmium plated or zinc passivated steel.

3) Control wiring to be done with 1100 V grade PVC wire, 2.5 mm stranded copper wire.

4) Cable glands and lugs shall be supplied loose alongwith transformer. See pt 22.  
Cable glands will be double compression nickel plated brass.  
Cable lugs will be installed with fixing hardware in the cable box.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 10 OF 18

**DATA SHEET (ANNEXURE –2)**

- 1) Manufacturer's Name and address :
- 2) Service Class / KVA rating :
- 3) Rated Voltage
  - a) HV Winding KV :
  - b) LV Winding KV :
- 4) Rated frequency :
- 5) Number of phases :
- 6) Connections
  - a) HV Winding :
  - b) LV Winding :
- 7) Connection symbol :
- 8) Type of cooling :
- 9) Tap changing equipment
  - a) Manufacturer :
  - b) Type :
  - c) Rated Voltage and Current :
  - c) No of steps :
  - d) Tap range % to % :
- 10) Guaranteed positive sequence impedance at 75 deg C with 100% rating
  - a) Principal tap :
  - b) Maximum tap (Approx) :
  - c) Minimum tap (Approx) :

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 11 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 11) Temp. rise over an ambient of 50 deg C
- a) Top oil deg C :
  - b) Winding (by resistance measurement method deg C ) :
- 12) Guaranteed losses at rated voltage on principal tap and at rated current rated frequency \*
- a) No load loss KW : (Max)
  - b) Copper loss at full load and 75 deg C KW : (Max)
- 13) Withstand time for three phase short circuit at terminals (sec.) :
- 14) Insulation level
- a) Separate source power frequency voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :
  - b) Induced over voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
  - c) Full wave lightning impulse withstand
    - i) HV Winding (KV) :
    - ii) LV Winding (KV) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :

**\* NOTE : LOSS FIGURES TO BE GIVEN WITHOUT ANY POSITIVE TOLERANCE. PLEASE SEE POINT 32 (PAGE 04) OF THIS SPECIFICATN.**



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 12 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

d) Switch impulse withstand voltage

i) HV Winding (KV) :

ii) LV Winding (KV) :

iii) HV Bushing :

15) Regulation at full load at 75 deg C

a) At unity power factor (percent) :

b) At 0.8 power factor (percent) :

16) Terminal arrangement

a) High Voltage :

b) Low Voltage :

c) HV Neutral :

17) Over excitation withstand time (sec)

a) 120% :

b) 150% :

18) Bushing

a) High Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 13 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

b) Low Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

c) Neutral (shall be available in HV Cable Box)

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

19) Proposed method of transformer shipment :

20) Total quantity of oil (litres) required for first filling :

21) Is vacuum filling required, if so, state absolute pressure :

22) Efficiency at 75 deg C at unity power factor

a) At full load ( percent ) :

b) At 3/4 full load (percent) :

c) At 1/2 full load (percent) :

23) Approximate dimensions

a) Tank enclosure (mm) :  
L x B x H

b) Overall L x B x H (mm)

24) Untanking height (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 14 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 25) Approximate weight (kg)
- a) Core
  - b) Winding – HV and LV
  - c) Insulation :
  - d) Tank – Enclosure and Cover :
  - e) Fittings :
  - f) Oil
  - g) Untanking weight :
  - g) Total weight :
- 26) Despatch details (Kg)
- a) Approximate mass of heaviest package (Kg) :
  - b) Approximate dimensions of largest package
    - i) Length (mm) :
    - ii) Breadth (mm) :
    - iii) Height (mm) :
  - c) Total Shipping weight :
  - d) Number of packages
  - e) Parts detached for transport like conservator, radiator, pipes, explosion vent etc.
- 27) Reference standards :
- 28) Type of Construction (Core/Shell) :
- 29) Thermal time constant (Hours) :
- 30) Magnetizing inrush current (Amps) :
- 31) No load current at rated frequency and at (Approx)
- i) 90% voltage (Amps) :
  - ii) 100% voltage (Amps) :
  - iii) 110% voltage (Amps) :
- 32) Power factor of no load current :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 15 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 33) Zero sequence impedance at principal tap :
- 34) Capacitance between winding and to earth (micro farads) :
- 35) Percentage reactance at rated current and frequency and at
  - i) Principal tap :
  - ii) Maximum tap :
  - iii) Minimum tap :
- 36) Radiator
  - i) Overall dimensions lxbxh (mm) :
  - ii) Total weight with oil (Kg) :
  - iii) Total weight without oil (Kg) :
  - iv) Type of mounting :
  - v) Thickness of Radiator tube(approx) radiator sheet steel (approx) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 16 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 37) Size of filter hose (mm) :
- 38) Core :
- a) Form of core :
- b) Net core area (mm<sup>2</sup>) :
- c) Type of joint between core and yoke :
- d) Thickness of stamping (mm) :
- e) Percentage silicon content (percent) :
- f) Maximum flux density in core at rated frequency and at
- i) 90% voltage (Wb/m<sup>2</sup>) :
- ii) 100% voltage (Wb/m<sup>2</sup>) :
- iii) 110% voltage (Wb/m<sup>2</sup>) :
- g) Type of core binding :
- 39) Winding
- a) Type of winding
- i) HV :
- ii) LV :
- b) Current density at rated load
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- c) Conductor area
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- d) Maximum current density under short circuit
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 17 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

40) Clearance

a) Minimum clearance between phase

i) In oil (mm) :

ii) In air (mm) :

b) Minimum clearance of HV winding to tank/enclosure (in oil, if applicable),(mm) :

c) Minimum clearance of HV winding to earth (In oil, if applicable),(mm) :

d) Clearance between core and coil (mm) :

e) Clearance between coils (mm) :

41) Tank/enclosure details

i) Side (mm) :

ii) Bottom (mm) :

iii) Cover (mm) :

42) Insulation levels

		<b>HV</b>	<b>LV</b>
i) Power Frequency	:	28 kV	3 kV
ii) Lightning Impulse	:	75 kV	10 kV

43) Bushings

		<b>HV</b>	<b>LV</b>
i) Type	:	Porcelain	Porcelain
ii) Rated Voltage	:	12 kV	3.0 kV
iii) Lightning Impulse	:	75 kV	10 kV
iv) Creepage distance	:	250mm	25mm
v) Power Frequency	:	28 kV	3.0 kV



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/063

REV. NO : 00

PAGE 18 OF 18

44) Magnetic Oil Level Gauge :  
(Dial type) Size

45) List of deviations (if any) : YES / NO  
enclosed with offer. If no deviations please mention  
the same here.

NOTE : The neutral on LV Side will be the 4<sup>th</sup> terminal on the LT Cable Box. Neutral will be earthed. Neutral to be insulated to full line voltage with adequate clearances and creepages as for Line Terminals. The neutral shall be capable of carrying full current. It will be connected to 4 wire 415V Switchboard with R-Y-B-N Busbars.

**Pre Qualification Criteria:**

1. The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers along with an authorization letter can submit offers. An authorized Representative/Dealer cannot quote for the same equipment from more than one OEM.
2. Offer shall be for a new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.
3. The vendor should have the capability to design Transformers for Rectifier duty. He should have already supplied and installed 3 nos. of similar rating transformers in India during the past 5 years and these must be operating satisfactorily for at least past one year. The details of the customers with contact details, transformers installed, date of installations etc. to be provided.
4. The vendor or their authorized service representatives shall have trained engineers for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for our installations.
5. The vendor shall be in a position to undertake AMC or provide service support for the equipment supplied, after the expiry of the warranty/ guarantee period either directly or through a service representative.
6. The vendor shall furnish a comprehensive warranty for at least 12 months from the date of commissioning.

**Note:**

1. Pre qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre qualification criteria are mandatory requirements and the technical bids will be evaluated only when the Pre Qualification criteria are met.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 - 12

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

P/PAGE 00 OF 18

**REVISION HISTORY SHEET**

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in any way detrimental to the interest of the company.

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	04.09.08	FIRST ISSUE	-----	-----	-----

REVISIONS 00

APPROVED BY

S.K.IYENGAR

PREPARED BY  
  
V SESHADRI

ISSUED BY  
TRACTION

DATE  
04/09/08



A4 - 10

### PURCHASE SPECIFICATION

GROUP : TRACTION ENGINEERING

P.S NO. : PS/445/064

REV. NO : 00

PAGE 01 OF 18

### SPECIFICATION FOR CONVERTER TRANSFORMER FOR HVDC / STATCOM FEEDER

LOCATION : CENTRE OF EXCELLENCE(COE), BHEL/EDN, BANGALORE  
APPLICATION : USED AT THE INPUT OF COE TEST FACILITY FOR HVDC / STATCOM

- 1. Quantity : 1 no.
- 2. Type of cooling : ONAN. Mineral oil filled
- 3. Rating (at all taps) : 100 KVA Continuous
- 4. Number of phases : 3
- 5. Voltages
  - Primary (L-L) (LV side) : 415 Volts  $\pm$  10% (Delta connection)
  - Secondary (L-L) (HV side) : 11000 volts (Star connection)
- 6. Frequency : 50Hz  $\pm$  5%
- 7. Combined volt & freq. variation : 10% (Absolute sum)
- 8. Number of winding : 2 – Both windings uniformly insulated. BIL Level 2 as per IS2026
- 9. Vector group : YNd1 (Primary to Secondary DYN11)  
With HT Neutral terminal as 4<sup>th</sup> terminal in HV Cable Box
- 10. Impedance / Tolerance : 8% on principal tap ( Minimum)  
Tolerance + 10 % - 0 %
- 10a. Voltage/ freq ratio : Shall be designed for 1.1 continuous.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

REVISION 00

APPROVED BY S K .IYENGAR

PREPARED BY  
*V. Seshadri*  
V SESHADRI

ISSUED BY  
TRACTION

DATE  
04/09/08



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 02 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

11. Installation : Outdoor  
(Under direct sunlight)
12. Ambient temp. : 50 Degree C
13. Duty : Rectifier duty.
14. Temperature rise
- (a) Design ambient temp. : 50 Degree C.
- (b) Temp. rise of top of oil by thermometer : 50 Degree C.
- (c) Temp. rise of wdg. by resistance method : 55 Degree C
15. Relative Humidity : 100 %
16. Short Ckt. level at 415V : 40 KA RMS
17. Suitability to withstand switching surges : Not Applicable. Switching on LV side with Air Circuit Breaker
18. a) Material of winding : Copper – Electrolytic Grade
- b) Core : Not to exceed  $1.7 \text{ Wb/m}^2$  at any tap position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. The laminated core shall be of high grade cold rolled grain oriented silicon steel.
- c) Tank : Tank shall be of welded construction and fabricated from tested low carbon steel. It shall be designed for a continuous internal pressure of 0.35 Kg/sq.cm over normal hydrostatic pressure of oil. The tank cover shall be sloped to prevent retention of rain water. All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket, in between for complete oil tightness. Bi – directional rollers, jacking pads( four nos) , lifting lugs shall be provided.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 03 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- d) Hardware : All nuts and bolts exposed to weather shall be hot dip galvanised or cadmium plated or zinc passivated steel.
19. Noise : Not to exceed values specified in NEMA TR-1.
20. Insulating oil : Fresh oil (before pouring into transformer) should be as per IS 335, without inhibitor. 10% extra oil shall be supplied for topping in non returnable containers in sealed drums.
21. Terminal arrangement : Suitable for termination of XLPE cable with Raychem type heat shrinkable terminating kits on HT side; 6 mm thick Aluminum blank (undrilled) gland plates to be supplied with H.T., L.T. and Mar-shalling boxes. Bushings of Porcelain conforming to IS 2099 & IS 3347. The minimum length between cable gland plate and cable lug to be 550 mm for both H.V. and L.T. side cable boxes. Terminal marking shall be as per IS 2026.
22. Tap changer : On HV winding – OFF circuit tap changer with padlocking facility as per IS 2026 with warning plate " SWITCH TO BE OPERATED WITH TRANSFORMER DE-ENERGISED"
23. Taps : Taps +/- 5 % in steps of +/- 2.5 %
24. Painting (Transformer and accessories) : Epoxy.
25. Shade : 631 of IS 5



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 04 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 26. Fittings and accessories : As per Annexure-1
- 27. Standards : IS 2026
- 28. Testing (Routine Tests) : As per IS 2026 with latest amendments
- 29. Quality plan : Supplier should submit his standard Quality Plan for approval.
- 30. Testing ( Type Tests) :Temperature Rise test on Transformer as per IS2026 with latest amendments
- 31. Vendor List : Vendor List for bought out Items to be submitted for . BHEL approval.
- 32. No load loss & Load Loss : Guaranteed maximum values without any positive tolerance shall be given with the offer. (See page 11 of this specification) An amount of Rs. 15000/- per KW of differential copper loss and Rs.60,000/- per KW of differential iron loss will be levied on the manufacturer, if these losses exceed the guaranteed losses quoted.
- 33. List of spares : Complete set of gaskets - 2 Sets  
Oil temp. indicator ( Dial Type) with alarm & trip contacts - 1 No  
Winding temp. indicator ( Dial Type) with alarm & trip contacts - 1 No



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 05 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- HV bushing with metal parts and gaskets. - 3 Nos
- LV bushing with metal parts and gaskets. - 3 Nos
- Tap changer assembly with contacts - 1 set
- Magnetic oil level gauge - 1 No
- Buchholz relay - 1 No
- Diaphragm of explosion vent - 3 Nos.
- Silica Gel Charge - 2 charges
- Set of valves (1 no. of each size) – 1 set
- Remote WTI Sensor (4-20mA) - 1 No.
- Remote OTI Sensor (4-20mA) - 1 No.

34. Information flow

- (A) The DATA SHEETS shall be completed fully and all guaranteed figures must be without any tolerance.  
Supplier must very clearly mention if any deviation is taken on the specification.
- (B) Following information shall be submitted after placement of order :
  - (a) All preliminary drawings for approval.
    - (i) 4 prints



A4 - 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 06 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- (b) All final drgs after approval
- (i) 6 prints
- (ii) Drawings in CD-ROM.

- (c) Test certificates and guarantee certificates
- (i) 3 copies

- (d) Instruction and maintenance Manuals - 5 copies

35. DATA SHEET

: DATA SHEET (Annexure – 3) is enclosed with this specification. The same is to be filled up and submitted alongwith the technical offer.

36. INFORMATION REQD WITH OFFER

- (i) Filled up data sheet
- (ii) Deviations to this specification. If there are no deviations, supplier must mention the same explicitly in their technical offer.
- (iii) Vendor List for all major bought-out items

Note : The test charges for Temperature Rise test must be mentioned in the price bid. However, a confirmation to that effect must be contained in the technical offer.

Unpriced copy of price bid must be enclosed in Technical offer.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 07 OF 18

**ANNEXURE - 1**

All accessories shall be provided confirming to IS 3639.  
The following fittings and accessories shall be provided:

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
01.	Oil filling hole with cover	1
02.	Conservator with sump & drain valve with plug/cover plate. The Breather shall be mounted at a height less than 1600 mm from the ground.	1
03.	a) Magnetic Oil level gauge(Dial type) with minimum and maximum filling level markings. It should have two independent electrically insulated low level alarm contacts suitable for 220 V DC.The oil level at 30 deg C shall be marked on the gauge. Contact suitable for 220 V DC.	1
	b) Prismatic oil level gauge	1
04.	Thermometer pockets	1
05.	Air release plug on tank cover	1
06.	Lifting lugs	1 SET
07.	Top filter valve	1
08.	Dehydrating breather with Silicagel and oil seal	1
09.	Off circuit tap changing switch on tank cover with tap position indicator, locks and handle.	1
10.	Rating and terminal marking stainless steel/anodised aluminum plate, with details etched in MKS & SI units.	1

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 08 OF 18

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
11.	Earthing terminals without lugs suitable for connecting 50x6 mm galvanized mild steel flat.	2
12.	Diagram plate	1
13.	Drain cum bottom filter valve	1
14.	Base channel with towing holes/lugs	2
15.	Double diaphragm explosion vent with sight glasses and equaliser pipe connection to conservator.	1
16.	Four Jacking Pads to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	1 SET
17.	Manufacturer's name plate (stainless steel/ Anodised Aluminium)	1
18.	Bi-directional rollers	1 SET
19.	Detachable radiator with bottom drain plug, top air release plug and top & bottom shut off valve.	1 SET
20.	Buchholz relay should be of double float type with testing & sampling cocks, alarm and trip contacts and one isolating valve on conservator side	1 SET
21.	150mm dial type oil temp. Indicator and winding temp. Indicators with max. pointer with alarm and trip contacts. Contacts suitable for 220V DC. Indicator accuracy $\pm 2\%$ . Alarm and trip points to be adjustable. Full scale temp. 240 deg C. Least count 2 deg C. Oil / Winding temp. Indicators should be provided with resetting device.	1 SET
22.	Cable glands & lugs Cable sizes shall be informed at the time of drawing finalisation. Cable lugs shall be of tinned copper for crimping to stranded aluminium conductor cable. Cable glands will be of double compression type.	1 SET

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 09 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
23.	Marshaling box (protection class IP55 and IS 2147) epoxy painted. Should be vermin, weather, dust proof. Terminal connector of control cable should be DOWELL make or equivalent. 20% extra spare terminals reqd. All TBs to be complete with insulating barriers, clip on type terminals suitable to 2.5 sq mm stranded copper wire. The marshaling box and temperature indicators shall not be mounted at a height greater than 1600 mm from the ground level. The box shall be tank mounted with sloping roof. All incoming cables shall enter from bottom. Sheet steel to be 1.6 mm thick. Thermostatically Controlled space heaters shall be provided.	1 No
24.	Inspection openings on tank with handles	2 Nos
25.	Remote WTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.
26.	Remote OTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.

NOTE :1) Contacts of all temp indicators, Buchholz relays and auxiliary devices shall be suitable for 220 V dc supply. All alarm and trip contacts shall also be suitable for 220 V dc circuits. External power supply will not be provided.

2) Nuts and bolts exposed to weather to be hot dipped galvanized or cadmium plated or zinc passivated steel.

3) Control wiring to be done with 1100 V grade PVC wire, 2.5 mm stranded copper wire.

4) Cable glands and lugs shall be supplied loose alongwith transformer. See pt 22.  
Cable glands will be double compression nickel plated brass.  
Cable lugs will be installed with fixing hardware in the cable box.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 10 OF 18

**DATA SHEET (ANNEXURE –2)**

- 1) Manufacturer's Name and address :
- 2) Service Class / KVA rating :
- 3) Rated Voltage
  - a) HV Winding KV :
  - b) LV Winding KV :
- 4) Rated frequency :
- 5) Number of phases :
- 6) Connections
  - a) HV Winding :
  - b) LV Winding :
- 7) Connection symbol :
- 8) Type of cooling :
- 9) Tap changing equipment
  - a) Manufacturer :
  - b) Type :
  - c) Rated Voltage and Current :
  - c) No of steps :
  - d) Tap range % to % :
- 10) Guaranteed positive sequence impedance at 75 deg C with 100% rating
  - a) Principal tap :
  - b) Maximum tap (Approx) :
  - c) Minimum tap (Approx) :

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 11 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 11) Temp. rise over an ambient of 50 deg C
- a) Top oil deg C :
  - b) Winding (by resistance measurement method deg C ) :
- 12) Guaranteed losses at rated voltage on principal tap and at rated current rated frequency \*
- a) No load loss KW : (Max)
  - b) Copper loss at full load and 75 deg C KW : (Max)
- 13) Withstand time for three phase short circuit at terminals (sec.) :
- 14) Insulation level
- a) Separate source power frequency voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :
  - b) Induced over voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
  - c) Full wave lightning impulse withstand
    - i) HV Winding (KV) :
    - ii) LV Winding (KV) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :

**\* NOTE : LOSS FIGURES TO BE GIVEN WITHOUT ANY POSITIVE TOLERANCE. PLEASE SEE POINT 32 (PAGE 04) OF THIS SPECIFICATN.**



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 12 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

d) Switch impulse withstand voltage

i) HV Winding (KV) :

ii) LV Winding (KV) :

iii) HV Bushing :

15) Regulation at full load at 75 deg C

a) At unity power factor (percent) :

b) At 0.8 power factor (percent) :

16) Terminal arrangement

a) High Voltage :

b) Low Voltage :

c) HV Neutral :

17) Over excitation withstand time (sec)

a) 120% :

b) 150% :

18) Bushing

a) High Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 13 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

b) Low Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

c) Neutral (shall be available in HV Cable Box)

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

19) Proposed method of transformer shipment :

20) Total quantity of oil (litres) required for first filling :

21) Is vacuum filling required, if so, state absolute pressure :

22) Efficiency at 75 deg C at unity power factor

a) At full load ( percent ) :

b) At 3/4 full load (percent) :

c) At 1/2 full load (percent) :

23) Approximate dimensions

a) Tank enclosure (mm) :  
L x B x H

b) Overall L x B x H (mm)

24) Untanking height (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 14 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 25) Approximate weight (kg)
- a) Core
  - b) Winding – HV and LV
  - c) Insulation :
  - d) Tank – Enclosure and Cover :
  - e) Fittings :
  - f) Oil
  - g) Untanking weight :
  - g) Total weight :
- 26) Despatch details (Kg)
- a) Approximate mass of heaviest package (Kg) :
  - b) Approximate dimensions of largest package
    - i) Length (mm) :
    - ii) Breadth (mm) :
    - iii) Height (mm) :
  - c) Total Shipping weight :
  - d) Number of packages
  - e) Parts detached for transport like conservator, radiator, pipes, explosion vent etc.
- 27) Reference standards :
- 28) Type of Construction (Core/Shell) :
- 29) Thermal time constant (Hours) :
- 30) Magnetizing inrush current (Amps) :
- 31) No load current at rated frequency and at (Approx)
- i) 90% voltage (Amps) :
  - ii) 100% voltage (Amps) :
  - iii) 110% voltage (Amps) :
- 32) Power factor of no load current :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 15 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 33) Zero sequence impedance at principal tap :
- 34) Capacitance between winding and to earth (micro farads) :
- 35) Percentage reactance at rated current and frequency and at
  - i) Principal tap :
  - ii) Maximum tap :
  - iii) Minimum tap :
- 36) Radiator
  - i) Overall dimensions lxbxh (mm) :
  - ii) Total weight with oil (Kg) :
  - iii) Total weight without oil (Kg) :
  - iv) Type of mounting :
  - v) Thickness of Radiator tube(approx) radiator sheet steel (approx) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 16 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 37) Size of filter hose (mm) :
- 38) Core :
- a) Form of core :
- b) Net core area (mm<sup>2</sup>) :
- c) Type of joint between core and yoke :
- d) Thickness of stamping (mm) :
- e) Percentage silicon content (percent) :
- f) Maximum flux density in core at rated frequency and at
- i) 90% voltage (Wb/m<sup>2</sup>) :
- ii) 100% voltage (Wb/m<sup>2</sup>) :
- iii) 110% voltage (Wb/m<sup>2</sup>) :
- g) Type of core binding :
- 39) Winding
- a) Type of winding
- i) HV :
- ii) LV :
- b) Current density at rated load
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- c) Conductor area
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- d) Maximum current density under short circuit
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 17 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

40) Clearance

a) Minimum clearance between phase

i) In oil (mm) :

ii) In air (mm) :

b) Minimum clearance of HV winding to tank/enclosure (in oil, if applicable),(mm) :

c) Minimum clearance of HV winding to earth (In oil, if applicable),(mm) :

d) Clearance between core and coil (mm) :

e) Clearance between coils (mm) :

41) Tank/enclosure details

i) Side (mm) :

ii) Bottom (mm) :

iii) Cover (mm) :

42) Insulation levels

		<b>HV</b>	<b>LV</b>
i) Power Frequency	:	28 kV	3 kV
ii) Lightning Impulse	:	75 kV	10 kV

43) Bushings

		<b>HV</b>	<b>LV</b>
i) Type	:	Porcelain	Porcelain
ii) Rated Voltage	:	12 kV	3.0 kV
iii) Lightning Impulse	:	75 kV	10 kV
iv) Creepage distance	:	250mm	25mm
v) Power Frequency	:	28 kV	3.0 kV



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/064

REV. NO : 00

PAGE 18 OF 18

44) Magnetic Oil Level Gauge :  
(Dial type) Size

45) List of deviations (if any) : YES / NO  
enclosed with offer. If no deviations please mention  
the same here.

NOTE : The neutral on HV Side will be the 4<sup>th</sup> terminal on the HT Cable Box.  
Neutral to be insulated to full line voltage with adequate clearances and creepages as for  
Line Terminals.

**Pre Qualification Criteria:**

1. The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers along with an authorization letter can submit offers. An authorized Representative/Dealer cannot quote for the same equipment from more than one OEM.
2. Offer shall be for a new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.
3. The vendor should have the capability to design Transformers for Rectifier duty. He should have already supplied and installed 3 nos. of similar rating transformers in India during the past 5 years and these must be operating satisfactorily for at least past one year. The details of the customers with contact details, transformers installed, date of installations etc. to be provided.
4. The vendor or their authorized service representatives shall have trained engineers for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for our installations.
5. The vendor shall be in a position to undertake AMC or provide service support for the equipment supplied, after the expiry of the warranty/ guarantee period either directly or through a service representative.
6. The vendor shall furnish a comprehensive warranty for at least 12 months from the date of commissioning.

**Note:**

1. Pre qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre qualification criteria are mandatory requirements and the technical bids will be evaluated only when the Pre Qualification criteria are met.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 - 12

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

P/AGE 00 OF 18

**REVISION HISTORY SHEET**

COPYRIGHT AND CONFIDENTIAL.  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	04.09.08	FIRST ISSUE	-----	-----	-----

REVISIONS 00

APPROVED BY

S.K.IYENGAR

PREPARED BY

V. Seshadri  
V SESHADRI

ISSUED BY

TRACTION

DATE

04/09/08



A4 - 10

### PURCHASE SPECIFICATION

GROUP : TRACTION ENGINEERING

P.S NO. : PS/445/065

REV. NO : 00

PAGE 01 OF 18

#### SPECIFICATION FOR CONVERTER TRANSFORMER FOR THREE LEVEL IGBT BASED INVERTER

LOCATION : CENTRE OF EXCELLENCE(COE), BHEL/EDN, BANGALORE  
APPLICATION : USED AT THE INPUT OF THREE LEVEL IGBT BASED  
INVERTER WITH ACTIVE FRONT END

- 1. Quantity : 1 no.
- 2. Type of cooling : ONAN. Mineral oil filled
- 3. Rating : 1500 KVA Continuous
- 4. Number of phases : 3
- 5. Voltages
  - Primary (L-L) (LV side) : 415 Volts  $\pm$  10% (Delta connection)
  - Secondary (L-L) (HV side) : 1. 3400 volts (Star connection)  
2. 3400 volts (Delta connection)
- 6. Frequency : 50Hz  $\pm$  5%
- 7. Combined volt & freq. variation : 10% (Absolute sum)
- 8. Number of winding : 3 - All windings uniformly insulated. BIL Level 2 as per IS2026
- 9. Vector group : Dd0 (Primary to Secondary DD0) and  
YNd11 (Primary to Secondary DYN1)  
With HT Neutral terminal as 4<sup>th</sup> terminal in HV Cable Box
- 10. Impedance / Tolerance : 8% on principal tap ( Minimum)  
8% between HV and LV-1 with LV-2 open  
8% between HV and LV-2 with LV-1 open  
Tolerance + 10 % - 0 %
- 10a. Coupling : The two LV windings should have minimum mutual leakage  
coupling inductance.
- 10b. Voltage/ freq ratio : Shall be designed for 1.1 continuous.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

REVISION 00

APPROVED BY S.K. IYENGAR

PREPARED BY  
*V. Seshadri*  
V SESHADRI

ISSUED BY  
TRACTION

DATE  
04/09/08



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 02 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

11. Installation : Outdoor  
(Under direct sunlight)
12. Ambient temp. : 50 Degree C
13. Duty : Rectifier duty.
14. Temperature rise
- (a) Design ambient temp. : 50 Degree C.
- (b) Temp. rise of top of oil by thermometer : 50 Degree C.
- (c) Temp. rise of wdg. by resistance method : 55 Degree C
15. Relative Humidity : 100 %
16. Short Ckt. level at 415V : 40 KA RMS
17. Suitability to withstand switching surges : Not Applicable. Switching on LV side with Air Circuit Breaker
18. a) Material of winding : Copper – Electrolytic Grade
- b) Core : Not to exceed  $1.7 \text{ Wb/m}^2$  at any tap position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. The laminated core shall be of high grade cold rolled grain oriented silicon steel.
- c) Tank : Tank shall be of welded construction and fabricated from tested low carbon steel. It shall be designed for a continuous internal pressure of 0.35 Kg/sq.cm over normal hydrostatic pressure of oil. The tank cover shall be sloped to prevent retention of rain water. All bolted connections shall be fitted with weather proof hot oil resistant neoprene gasket, in between for complete oil tightness. Bi – directional rollers, jacking pads( four nos) , lifting lugs shall be provided.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 03 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- d) Hardware : All nuts and bolts exposed to weather shall be hot dip galvanised or cadmium plated or zinc passivated steel.
19. Noise : Not to exceed values specified in NEMA TR-1.
20. Insulating oil : Fresh oil (before pouring into transformer) should be as per IS 335, without inhibitor. 10% extra oil shall be supplied for topping in non returnable containers in sealed drums.
21. Terminal arrangement : Suitable for termination of XLPE cable with Raychem type heat shrinkable terminating kits on HT side; Terminals for 50% Tap on HV Winding to be separately terminated in HV Cable box. 6 mm thick Aluminum blank (undrilled) gland plates to be supplied with H.T., L.T. and Marshalling boxes. Bushings of Porcelain conforming to IS 2099 & IS 3347. The minimum length between cable gland plate and cable lug to be 550 mm for both H.V. and L.T. side cable boxes. Terminal marking shall be as per IS 2026.
22. Tap changer : On LV winding – OFF circuit tap changer with padlocking facility as per IS 2026 with warning plate  
" SWITCH TO BE OPERATED WITH TRANSFORMER DE-ENERGISED"
23. Taps : Taps +/- 5 % in steps of +/- 2.5 % on LV. Tap at 1700V (50%) on both HV windings
24. Painting (Transformer and accessories) : Epoxy.
25. Shade : 631 of IS 5



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 04 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 26. Fittings and accessories : As per Annexure-1
- 27. Standards : IS 2026
- 28. Testing (Routine Tests) : As per IS 2026 with latest amendments
- 29. Quality plan : Supplier should submit his standard Quality Plan for approval.
- 30. Testing ( Type Tests) :Temperature Rise test on Transformer as per IS2026 with latest amendments  
Capacitance and tan delta between windings, shield (all combinations). During all routine and type tests, the shield is to be earthed.
- 31. Vendor List : Vendor List for bought out Items to be submitted for . BHEL approval.
- 32. No load loss & Load Loss : Guaranteed maximum values without any positive tolerance shall be given with the offer. (See page 11 of this specification)  
An amount of Rs. 15000/- per KW of differential copper loss and Rs.60,000/- per KW of differential iron loss will be levied on the manufacturer, if these losses exceed the guaranteed losses quoted.
- 33. Harmonics : Each LV winding is connected to a 6 pulse rectifier. The current spectrum of the harmonics in each LV Winding is: (in % of fundamental current)  
5<sup>th</sup>: 25; 7<sup>th</sup>:14; 11<sup>th</sup>: 9; 13<sup>th</sup>: 6.5; 17<sup>th</sup>: 4; 19<sup>th</sup>: 3.5; 23: 3; 25<sup>th</sup>: 2; 29<sup>th</sup>: 1.5; 31<sup>st</sup>: 1.5; 35<sup>th</sup>: 1; 37<sup>th</sup>: 1; 41<sup>st</sup>: 0.3; 43<sup>rd</sup>: 0.3; 47<sup>th</sup>: 0.2; 49<sup>th</sup>: 0.2  
The transformer shall be designed to ensure that no overheating occurs because of the presence of Harmonics
- 34. Design considerations for double Secondary Transformers : The 2 secondary windings are magnetically uncoupled one from the other. This means that the transformer has the property that whenever it is fed on primary winding from a grid of infinite short circuit power, the no load voltage on one secondary winding in open circuit is quasi-independent of the load connected to the other secondary winding, even for a short circuit. In short, the 2 secondary windings transformer has the same behavior as 2 separate transformers.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 05 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

35. Provision of Shield : To ensure a correct capacitance insulation between the primary and the secondary windings, an electrostatic screen connected to earth is provided. It should be ensured that the screen is properly insulated and securely fastened to ensure that no damage occurs in transit/shipping/operation. The earthing connection should be properly made.

33. List of spares : Complete set of - 2 Sets  
gaskets  
Oil temp. indicator ( Dial Type) - 1 No  
with alarm & trip contacts  
Winding temp. indicator (Dial Type) - 1 No  
with alarm & trip contacts  
HV bushing with metal parts - 3 Nos  
and gaskets.  
LV bushing with metal parts - 3 Nos  
and gaskets.  
Tap changer assembly  
with contacts - 1 set  
Magnetic oil level gauge - 1 No  
Buchholz relay - 1 No  
Diaphragm of explosion vent - 3 Nos.  
Silica Gel Charge - 2 charges  
Set of valves (1 no. of each size) – 1 set  
Remote WTI Sensor (4-20mA) - 1 No.  
Remote OTI Sensor (4-20mA) - 1 No.

34. Information flow : (A) The DATA SHEETS shall be completed fully and all guaranteed figures must be without any tolerance.  
Supplier must very clearly mention if any deviation is taken on the specification.  
  
(B) Following information shall be submitted after placement of order :  
  
(a) All preliminary drawings for approval.  
(i) 4 prints



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 06 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- (b) All final drgs after approval
- (i) 6 prints
- (ii) Drawings in CD-ROM.

- (c) Test certificates and guarantee certificates
- (i) 3 copies

- (d) Instruction and maintenance Manuals - 5 copies

**35. DATA SHEET**

: DATA SHEET (Annexure – 3) is enclosed with this specification. The same is to be filled up and submitted alongwith the technical offer.

**36. INFORMATION REQD WITH OFFER**

- : (i) Filled up data sheet
- (ii) Deviations to this specification. If there are no deviations, supplier must mention the same explicitly in their technical offer.
- (iii) Vendor List for all major bought-out items
- (iv) Writeup on constructional aspects of the transformer including details of achieving minimum coupling between secondary windings.

**37. Operation and Usage**

- : (a) Both secondary windings when connected at 3400V position are connected to a 3 level IGBT Inverter. Both secondary currents will be equal and each secondary winding to deliver 750KVA.
- (b) Both secondary windings when connected at 1700V tap are connected to a 3 level IGBT Inverter. Both secondary currents will be equal and each secondary winding to deliver 375KVA.

**Note :** The test charges for Temperature Rise test must be mentioned in the price bid. However, a confirmation to that effect must be contained in the technical offer.

Unpriced copy of price bid must be enclosed in Technical offer.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 07 OF 18

**ANNEXURE - 1**

All accessories shall be provided confirming to IS 3639.  
The following fittings and accessories shall be provided:

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
01.	Oil filling hole with cover	1
02.	Conservator with sump & drain valve with plug/cover plate. The Breather shall be mounted at a height less than 1600 mm from the ground.	1
03.	a) Magnetic Oil level gauge(Dial type) with minimum and maximum filling level markings. It should have two independent electrically insulated low level alarm contacts suitable for 220 V DC.The oil level at 30 deg C shall be marked on the gauge. Contact suitable for 220 V DC.	1
	b) Prismatic oil level gauge	1
04.	Thermometer pockets	1
05.	Air release plug on tank cover	1
06.	Lifting lugs	1 SET
07.	Top filter valve	1
08.	Dehydrating breather with Silicagel and oil seal	1
09.	Off circuit tap changing switch on tank cover with tap position indicator, locks and handle.	1
10.	Rating and terminal marking stainless steel/anodised aluminum plate, with details etched in MKS & SI units.	1

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 08 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
11.	Earthing terminals without lugs suitable for connecting 50x6 mm galvanized mild steel flat.	2
12.	Diagram plate	1
13.	Drain cum bottom filter valve	1
14.	Base channel with towing holes/lugs	2
15.	Double diaphragm explosion vent with sight glasses and equaliser pipe connection to conservator.	1
16.	Four Jacking Pads to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	1 SET
17.	Manufacturer's name plate (stainless steel/ Anodised Aluminium)	1
18.	Bi-directional rollers	1 SET
19.	Detachable radiator with bottom drain plug, top air release plug and top & bottom shut off valve.	1 SET
20.	Buchholz relay should be of double float type with testing & sampling cocks, alarm and trip contacts and one isolating valve on conservator side	1 SET
21.	150mm dial type oil temp. Indicator and winding temp. Indicators with max. pointer with alarm and trip contacts. Contacts suitable for 220V DC. Indicator accuracy $\pm 2\%$ . Alarm and trip points to be adjustable. Full scale temp. 240 deg C. Least count 2 deg C. Oil / Winding temp. Indicators should be provided with resetting device.	1 SET
22.	Cable glands & lugs Cable sizes shall be informed at the time of drawing finalisation. Cable lugs shall be of tinned copper for crimping to stranded aluminium conductor cable. Cable glands will be of double compression type.	1 SET



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 09 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

<u>SL.NO</u>	<u>DESCRIPTION</u>	<u>QTY</u>
23.	Marshaling box (protection class IP55 and IS 2147) epoxy painted. Should be vermin, weather, dust proof. Terminal connector of control cable should be DOWELL make or equivalent. 20% extra spare terminals reqd. All TBs to be complete with insulating barriers, clip on type terminals suitable to 2.5 sq mm stranded copper wire. The marshaling box and temperature indicators shall not be mounted at a height greater than 1600 mm from the ground level. The box shall be tank mounted with sloping roof. All incoming cables shall enter from bottom. Sheet steel to be 1.6 mm thick. Thermostatically Controlled space heaters shall be provided.	1 No
24.	Inspection openings on tank with handles	2 Nos
25.	Remote WTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.
26.	Remote OTI Sensor - Transducer (4-20mA) Auxiliary Voltage – 240V AC	- 1 No.

NOTE :1) Contacts of all temp indicators, Buchholz relays and auxiliary devices shall be suitable for 220 V dc supply. All alarm and trip contacts shall also be suitable for 220 V dc circuits. External power supply will not be provided.

2) Nuts and bolts exposed to weather to be hot dipped galvanized or cadmium plated or zinc passivated steel.

3) Control wiring to be done with 1100 V grade PVC wire, 2.5 mm stranded copper wire.

4) Cable glands and lugs shall be supplied loose alongwith transformer. See pt 22.  
Cable glands will be double compression nickel plated brass.  
Cable lugs will be installed with fixing hardware in the cable box.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 10 OF 18

**DATA SHEET (ANNEXURE –2)**

- 1) Manufacturer's Name and address :
- 2) Service Class / KVA rating :
- 3) Rated Voltage
  - a) HV Winding KV :
  - b) LV Winding KV :
- 4) Rated frequency :
- 5) Number of phases :
- 6) Connections
  - a) HV Winding :
  - b) LV Winding :
- 7) Connection symbol :
- 8) Type of cooling :
- 9) Tap changing equipment
  - a) Manufacturer :
  - b) Type :
  - c) Rated Voltage and Current :
  - c) No of steps :
  - d) Tap range % to % :
- 10) Guaranteed positive sequence impedance at 75 deg C with 100% rating
  - a) Principal tap :
  - b) Maximum tap (Approx) :
  - c) Minimum tap (Approx) :

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 11 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 11) Temp. rise over an ambient of 50 deg C
- a) Top oil deg C :
  - b) Winding(by resistance measurement method deg C ) :
- 12) Guaranteed losses at rated voltage on principal tap and at rated current rated frequency \*
- a) No load loss KW : (Max)
  - b) Copper loss at full load and 75 deg C KW : (Max)
- 13) Withstand time for three phase short circuit at terminals (sec.) :
- 14) Insulation level
- a) Separate source power frequency voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :
  - b) Induced over voltage withstand
    - i) HV Winding (KV rms) :
    - ii) LV Winding (KV rms) :
  - c) Full wave lightning impulse withstand
    - i) HV Winding (KV) :
    - ii) LV Winding (KV) :
    - iii) HV Bushing :
    - iv) LV Bushing :
    - v) Neutral Bushing :

**\* NOTE : LOSS FIGURES TO BE GIVEN WITHOUT ANY POSITIVE TOLERANCE. PLEASE SEE POINT 32 (PAGE 04) OF THIS SPECIFICATN.**



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 12 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

d) Switch impulse withstand voltage

i) HV Winding (KV) :

ii) LV Winding (KV) :

iii) HV Bushing :

15) Regulation at full load at 75 deg C

a) At unity power factor (percent) :

b) At 0.8 power factor (percent) :

16) Terminal arrangement

a) High Voltage :

b) Low Voltage :

c) HV Neutral :

17) Over excitation withstand time (sec)

a) 120% :

b) 150% :

18) Bushing

a) High Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 13 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

b) Low Voltage

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

c) Neutral (shall be available in HV Cable Box)

i) Manufacturer :

ii) Type :

iii) Minimum creepage distance (mm) :

19) Proposed method of transformer shipment :

20) Total quantity of oil (litres) required for first filling :

21) Is vacuum filling required, if so, state absolute pressure :

22) Efficiency at 75 deg C at unity power factor

a) At full load ( percent ) :

b) At 3/4 full load (percent) :

c) At 1/2 full load (percent) :

23) Approximate dimensions

a) Tank enclosure (mm) :  
L x B x H

b) Overall L x B x H (mm)

24) Untanking height (mm) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 14 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 25) Approximate weight (kg)
- a) Core
  - b) Winding – HV and LV
  - c) Insulation :
  - d) Tank – Enclosure and Cover :
  - e) Fittings :
  - f) Oil
  - g) Untanking weight :
  - g) Total weight :
- 26) Despatch details (Kg)
- a) Approximate mass of heaviest package (Kg) :
  - b) Approximate dimensions of largest package
    - i) Length (mm) :
    - ii) Breadth (mm) :
    - iii) Height (mm) :
  - c) Total Shipping weight :
  - d) Number of packages
  - e) Parts detached for transport like conservator, radiator, pipes, explosion vent etc.
- 27) Reference standards :
- 28) Type of Construction (Core/Shell) :
- 29) Thermal time constant (Hours) :
- 30) Magnetizing inrush current (Amps) :
- 31) No load current at rated frequency and at (Approx)
- i) 90% voltage (Amps) :
  - ii) 100% voltage (Amps) :
  - iii) 110% voltage (Amps) :
- 32) Power factor of no load current :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 15 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 33) Zero sequence impedance at principal tap :
- 34) Capacitance between winding and to earth (micro farads) :
- 35) Percentage reactance at rated current and frequency and at
  - i) Principal tap :
  - ii) Maximum tap :
  - iii) Minimum tap :
- 36) Radiator
  - i) Overall dimensions lxbxh (mm) :
  - ii) Total weight with oil (Kg) :
  - iii) Total weight without oil (Kg) :
  - iv) Type of mounting :
  - v) Thickness of Radiator tube(approx) radiator sheet steel (approx) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 16 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 37) Size of filter hose (mm) :
- 38) Core :
- a) Form of core :
- b) Net core area (mm<sup>2</sup>) :
- c) Type of joint between core and yoke :
- d) Thickness of stamping (mm) :
- e) Percentage silicon content (percent) :
- f) Maximum flux density in core at rated frequency and at
- i) 90% voltage (Wb/m<sup>2</sup>) :
- ii) 100% voltage (Wb/m<sup>2</sup>) :
- iii) 110% voltage (Wb/m<sup>2</sup>) :
- g) Type of core binding :
- 39) Winding :
- a) Type of winding
- i) HV :
- ii) LV :
- b) Current density at rated load
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- c) Conductor area
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :
- d) Maximum current density under short circuit
- i) HV (A/mm<sup>2</sup>) :
- ii) LV (A/mm<sup>2</sup>) :



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 17 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

40) Clearance

a) Minimum clearance between phase

i) In oil (mm) :

ii) In air (mm) :

b) Minimum clearance of HV winding to tank/enclosure (in oil, if applicable),(mm) :

c) Minimum clearance of HV winding to earth (In oil, if applicable),(mm) :

d) Clearance between core and coil (mm) :

e) Clearance between coils (mm) :

41) Tank/enclosure details

i) Side (mm) :

ii) Bottom (mm) :

iii) Cover (mm) :

42) Insulation levels

		<b>HV</b>	<b>LV</b>
i) Power Frequency	:	10 kV	3 kV
ii) Lightning Impulse	:	40 kV	10 kV

43) Bushings

		<b>HV</b>	<b>LV</b>
i) Type	:	Porcelain	Porcelain
ii) Rated Voltage	:	3.6 kV	3.0 kV
iii) Lightning Impulse	:	40 kV	10 kV
iv) Creepage distance	:	75mm	25mm
v) Power Frequency	:	10 kV	3.0 kV



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP : TRACTION ENGINEERING**

P.S NO. : PS/445/065

REV. NO : 00

PAGE 18 OF 18

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.

- 44) Magnetic Oil Level Gauge :  
(Dial type) Size
- 45) Confirm that all figures / data given in this data sheet are with shield in Point 35 of specification in earthed condition : CONFIRMED
- 46) List of deviations (if any) : YES / NO enclosed with offer. If no deviations please mention the same here.

NOTE : The neutral on HV Side will be the 4<sup>th</sup> terminal on the HT Cable Box. Neutral will be kept floating in actual service.  
Neutral to be insulated to full line voltage with adequate clearances and creepages as for Line Terminals.  
The electrostatic shield in point 35 of Specification (Page 05) shall be earthed in service.

**Pre Qualification Criteria:**

1. The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers along with an authorization letter can submit offers. An authorized Representative/Dealer cannot quote for the same equipment from more than one OEM.
2. Offer shall be for a new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.
3. The vendor should have the capability to design Transformers for Rectifier duty. He should have already supplied and installed 3 nos. of similar rating transformers in India during the past 5 years and these must be operating satisfactorily for at least past one year. The details of the customers with contact details, transformers installed, date of installations etc. to be provided.
4. The vendor or their authorized service representatives shall have trained engineers for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for our installations.
5. The vendor shall be in a position to undertake AMC or provide service support for the equipment supplied, after the expiry of the warranty/ guarantee period either directly or through a service representative.
6. The vendor shall furnish a comprehensive warranty for at least 12 months from the date of commissioning.

**Note:**

1. Pre qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre qualification criteria are mandatory requirements and the technical bids will be evaluated only when the Pre Qualification criteria are met.

**General Terms & Conditions for Supply of Imported & Indigenous Capital Items (Two part bid)**

Bidders are required to read the general terms & conditions carefully and submit their quotation covering all the points. Any order resulting from this enquiry shall be governed by the general terms and conditions listed below.

1. **TWO PART BID:** Quotation shall be submitted in two part bid i.e.

- a) **Techno-commercial i.e., Un-priced Bid:** Techno-commercial bid shall be submitted with complete description of the equipment, specification compliances to the enquired specification and all the commercial terms & conditions indicated in the **QUOTATION FORMAT (ANNEXURE - A / ANNEXURE - B)** preferably in the same format. Any other enclosure, which the supplier wishes to submit like product catalogue, technical literature etc., may also be submitted in a sealed envelope super scribed clearly as **“TECHNO-COMMERCIAL BID” with RFQ No. and DUE DATE.** Un-priced copy of price bid (without price) shall also be enclosed with the techno-commercial bid i.e. a copy of the price bid without prices.

Confirmation to BHEL specifications shall be indicated by the vendor in the respective columns provided in the purchase specification wherever applicable. Deviations to the specification / item description, if any shall be brought out clearly indicating **“DEVIATION TO BHEL SPECIFICATION”** without fail as a part of technical offer.

Compliance to Pre-qualification criteria (if applicable) shall also be enclosed with the Techno-commercial bid.

Manufacturer's name, their trade mark and brand if any, should be invariably mentioned in the tender and illustrative leaflets giving technical particulars etc., are to be attached to the tender to facilitate consideration of the offer.

b) **Price Bid :**

Price bid should contain basic unit prices, discount if any, applicable taxes & duties, packing & forwarding charges (if applicable), Freight & insurances (if applicable) FOB charge (if applicable) etc., in a sealed envelope super scribed clearly as **“PRICE BID” with RFQ No. and DUE DATE.** Installation, commissioning, start-up and training charges (if any) shall also be included in the price bid.

Please indicate the rates in both figures and words. However in case of difference / discrepancy, the rates indicated in figures shall be considered as correct.

Both these sealed envelopes [(a) Techno-commercial i.e., un-priced Bid and (b) Price Bids] shall be kept in a single sealed envelope and superscribed clearly with **RFQ No. and DUE DATE.**

2. The above sealed envelope (Tender) shall reach our office on or before the due date by **13:00 hrs.** Quotations are to be dropped in the tender box marked for the OPENING ON respective days i.e., MONDAY / WEDNESDAY / FRIDAY kept at BHEL-EDN's Reception area of our works with caption "CE, M&C, SC&PV, TSC, DEFENCE, TELECOM, CPD". Quotations also can be dispatched by Couriers / Registered post / FAX / e mail to the Purchase Executive indicated in the RFQ. Late Tenders i.e. Tenders received after due date & time are liable to be rejected.
3. The rates quoted against each item shall be in the same units stated in the enquiry. If the quotations are submitted in any other unit than specified, relationship between two sets of units must be furnished in the offer.
4. As far as possible, the quotations shall be free from corrections / overwriting. Corrections if any should be initialed with your seal and signature. Any typographical errors, totaling mistakes, currency mistakes, multiplication mistakes, summary mistakes observed in your priced bids, BHEL may consider whichever is beneficial to BHEL for evaluation.
5. Quotations are to be duly signed. Unsigned bids/offers are liable for rejection.
6. All the bidders or their authorized representatives (with authorization letter from their principals) can witness opening of techno-commercial bid on the due date.
7. After evaluation of techno-commercial bids, price bids of only those which are technically & commercially accepted, will be opened on a subsequent date, which will be intimated to the concerned in advance for witnessing of price bid opening.
8. The quantities in each item to be purchased may vary from quantities enquired according to the actual requirement at the time of placing the purchase order. Quantity discount if any should be mentioned in your offer.
9. BIDDERS (for indigenous purchase) shall indicate clearly Excise duty, Education cess, Sales Tax/VAT, Octroi, Entry tax, Service Tax as applicable for the quoted items. In the absence of clarity of these, any claim at a later date will not be entertained. Any changes in Taxes and duties after award of the contract will not be considered except such are those, which are imposed by Govt., notification within the contractual delivery. Seeking price amendments for change in Excise duty due to crossing of turnover limits will not be considered under any circumstances.
10. **TOTAL COST TO BHEL:** Purchase order will be placed on the lowest bidder (L1) only among the technically & commercially accepted offers. Lowest Bid (L1) is determined on the basis of the total cost to BHEL.

**(a) FOR FOREIGN PURCHASE:**

Total cost to BHEL = Total basic value in foreign currency + FOB charges (if any) + Packing & Forwarding charges (if any) + Cost Insurance Freight (CIF) + Basic Custom Duty (BCD) + Counter Veiling Duty (CVD) + Educational Cess + Special Additional Duty (SAD) + Entry TAX + Service TAX (if applicable) + Loading factors for deviations to commercial terms & conditions.

Note: Exchange rate ruling on the date of Tender opening (Techno-commercial / un-priced Bid) will be considered for converting foreign currency to Indian currency. Exchange rates published in Economic Times (TT selling) will be considered.

**(b) FOR INDIGENOUS PURCHASE:**

Total cost to BHEL = Total basic value + Packing & forwarding charges + Excise duty Education cess + sales Tax/VAT + Octroi + Exit/Entry tax + Freight & Insurance + Service Tax (if applicable) + Loading factors for deviations to commercial terms & conditions.

**11. FIRM PRICE:** Rates quoted should be firm and no enhancement in the rates and changes in the techno-commercial terms will be allowed once the quotation is accepted and order is placed.

If Installation & Commissioning is in supplier's scope, then the price shall remain FIRM till commissioning & handing over of the complete system.

**12. TERMS OF PAYMENT:**

**(a) FOR FOREIGN PURCHASE:**

Payment will be made against “**SIGHT DRAFT**” on presentation of documents to our bankers. Payment through LC is also made subject to loading factors as per **Clause 26 (Ai)**.

The payment terms are as follows:

- a) 100% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Nil shortage certificate, Certificate of country of origin etc., (where commissioning & warranty is NOT involved).
- b) 90% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Warrantee certificate, Nil shortage certificate, Certificate of country of origin etc., & 10 % on submission of Performance Bank Guarantee (PBG) (where commissioning is NOT involved).
- c) 75% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Warrantee certificate, Nil shortage certificate, Certificate of country of origin etc., 15% on successful installation, commissioning and start-up trials & 10% on submission of Performance Bank Guarantee (PBG).
- d) If PBG is not submitted by the vendor, then the final 10% payment will be made against submission of supplementary invoice after warranty period + 6 months of claim period.

**(b) FOR INDIGENOUS PURCHASE:**

- a) 100% within 30 days from the date of receipt of equipments / materials (where commissioning & warranty is NOT involved).
- b) 90% within 30 days from the date of receipt of equipments & balance 10% against submission of PBG (where commissioning is NOT involved).
- c) 75% within 30 days from the date of receipt of equipments, 15% after the successful installation, commissioning & start-up trials & balance 10% against submission of PBG (wherever commissioning & warranty are involved).

d) If PBG is not submitted by the vendor, then the final 10% payment will be made against submission of supplementary invoice after warranty period + 6 months of claim period.

**13. ADVANCE PAYMENT:** Quotations with payment terms of “Advance” or “Inland Letter of Credit” will not be considered and such offers are liable for rejection commercially.

**14. PENALTY:** Failure to supply the item within the delivery date specified in the purchase order will make the supplier liable to an unconditional penalty of ½% (One half percent) of the basic value of the goods in arrears per week subject to a maximum of 10%.

If pre-shipment inspection is involved, date of issue of pre-shipment call by the vendor along with test certificates / test reports / certificate of conformance / calibration reports as proof of completion will be treated as date of dispatch for the purpose of penalty calculation.

In the absence of reports stated above, actual date of inspection will be considered as date of dispatch for penalty calculation.

**15. PBG:** Performance Bank Guarantee (PBG) to be submitted as per the BHEL prescribed format given in **ANNEXURE - D / ANNEXURE - E** for 10% of the basic equipment value obtained from any BHEL member banks.

PBG shall be valid for 12 months from the date of commissioning or 18 months from the date of dispatch whichever is earlier. The PBG shall also have 6 months claim period from the date of dispatch / commissioning.

The Bank Guarantee shall be submitted directly to the concerned Purchase Executive by the issuing Bank with their forwarding letter.

**16. WARRANTY:** Goods dispatched shall have warranty period of 12 months from the date of dispatch or as mentioned in the RFQ.

**17. TERMS OF DELIVERY:**

**(a) FOR IMPORTED PURCHASE:**

Price offered shall be for goods packed and delivered **F.O.B.** (named international Airport) including packing, forwarding, Handling, Ancillary charges like processing of Sight Draft, Letter of credit (L/C) if applicable, negotiation of bank documents, Export declaration, Certificate of origin etc.

Packing shall be Airworthy & Roadworthy, best suitable for trans-shipment and to prevent transit damages.

Vendors shall indicate the name of International Airport.

Note: Name of International Airport has to be selected from any one of the airports indicated in the table provided in **ANNEXURE - C** herewith.

**(b) FOR INDIGENOUS PURCHASE:**

Equipment shall be delivered on EX-EDN/BHEL, Bangalore basis, inclusive of packing & forwarding charges.

Packing shall be Road / Air / Rail worthy, best suitable for transshipment and to take care of transit damages.

Dispatch the consignments through EDN/BHEL approved transporters on Door Delivery basis furnished below.

1. M/s Awagaman Road Carriers Ltd., Bangalore. (AWG)
2. M/s BLR India pvt., Ltd., Bangalore. (BLR)
3. M/s Delhi Assam Roadways corporation Ltd., Bangalore. (DRL)
4. M/s Indo Arya Central transport Ltd., Bangalore. (IACT)
5. M/s Prakash parcel Services, Bangalore. (PPS)
6. M/s Road Carrier of India, Bangalore. (RCI)
7. M/s Union Roadways Ltd., Bangalore. (URL)

Small consignments can be dispatched through M/S First Flight Couriers Ltd.

Transit insurance shall be arranged by BHEL. Vendor shall intimate the dispatch details to BHEL immediately after effecting shipment, to arrange transit insurance accordingly.

**18. DELIVERY REQUIREMENT:** Equipment shall be delivered, as per the delivery schedule indicated in the RFQ.

**19. VALIDITY:** Quotation should remain valid for a period of **90 days** from the date of technical bid opening.

**20.** BHEL reserves the right to RE-FLOAT/REJECT/CANCEL the TENDER ENQUIRY (RFQ) without assigning any reason or cause thereof. Quotes received against this TENDER ENQUIRY are subject to and governed by all these terms and conditions. BHEL's decision will be final in awarding of the contract and binding on all vendors.

**21. REVERSE AUCTION:** BHEL reserves the right to resort to reverse auction / online Bidding before opening of price bid.

**22. POST-ORDER REQUISITES:**

- a) Pre-shipment inspection at vendor's works, if required, will be carried out by BHEL. Required assistance will have to be provided by the vendor at the time of pre-shipment inspection.
- b) Test certificates, Calibration certificates and warranty certificates as stipulated at the time of ordering shall be furnished.
- c) Items shall be dispatched by Air/Road/Sea worthy packing. Any damage and later rejection, due to poor / improper packing shall be to supplier's account.
- d) Any damage/rejection should be made good or replaced immediately without any extra cost to BHEL.
- e) Wherever commissioning is involved, it shall be carried out by the vendor's qualified engineers. Scope of work includes installation, commissioning and start-up trials till satisfactory performance level is reached as certified by BHEL.
- f) BHEL will not be responsible for any loss, damage or injuries to vendor's personnel sustained during installation / commissioning / start-up trials. Vendor shall ensure compliance with all statutory requisites as laid down by local bodies, state & Central Government.
- g) Performance Bank Guarantee to be executed on Rs.100/- non-judicial stamp paper as per BHEL prescribed format as given as Annexure (c).

23. Any dispute arising out of this contract shall be referred to the sole arbitration of Head of Materials Management, Control Equipment, BHEL, EDN, Bangalore or any other officer nominated by him and his decision shall be final and binding on the parties. The venue of the arbitration in all cases shall be Bangalore.
24. All suits in respect of the above lie in the court of Jurisdiction of Bangalore (India) only.
25. Equipment shall comply with the standard requirements of ISO 14001 & OHSAS 18001.
26. **REGRET LETTER:** In case, the supplier is unable / not willing to quote (for BHEL's registered vendors), a letter of regret shall be sent.

**27. LOADING FACTORS:**

Loading factors as detailed below will be added to the quoted price (basic) to evaluate the lowest quote for non compliance of BHEL standard commercial terms.

**A(i). For non compliance of standard Terms of payment (For Foreign Purchase Orders)**

Sl. No.	BHEL standard term	If you quote	Loading factor in % for non-compliance
1	100% against "SIGHT DRAFT" on presentation of dispatch documents to our Bankers.	(a) 100% Through Letter of Credit (LC)	(a) 3.50 %
2	90% against "SIGHT DRAFT" + 10% against PBG (wherever PBG is involved)	(b) 90% Through Letter of Credit (LC)	(b) 2.25 %
3	75% against "SIGHT DRAFT" + 15% after commissioning + 10% against PBG (wherever commissioning & PBG is involved)	(c) 75% Through Letter of Credit (LC)	(c) 1.875 %

**A(ii). For non compliance of standard Terms of payment (For Indigenous Purchase Orders)**

Sl. No.	BHEL standard term	If you quote	Loading factor in % for non-compliance
1	100% within 30 days from the date of receipt (credit payment)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1.25 % x percentage quoted through proforma invoice
2	90% within 30 days from the date of receipt + 10% against PBG (wherever PBG is involved)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1.25 % x percentage quoted through proforma invoice
		100% within 30 days from the date of receipt &	Nil

		PBG	
3	75% within 30 days from the date of receipt + 15% after commissioning + 10% against PBG (wherever commissioning & PBG is involved)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1.25 % x percentage quoted through proforma invoice
		100% within 30 days and after commissioning & PBG	Nil

**B. For non compliance of Penalty clause:**

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	Penalty of 0.5% per week subject to max. of 10% on the basic value of the items not supplied /delayed	Not agreed.	10 %
		5% max., agreed.	5%
		Other than the above.	10% - (minus) agreed max. %

**C. For non compliance of Performance Bank Guarantee (PBG):**

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format.	Not agreed.	10 %
		5% agreed.	5 %
		Other than the above.	10% - (minus) agreed max. %

**D. For Non conformance to delivery requirement indicated in the RFQ:**

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	Delivery requirement as indicated in the RFQ in number of weeks from the date of issue of PO or from the document approval	Not agreed for the stipulated delivery in the enquiry	1 % per week up to max. of 10% for the difference in period

**E. For non compliance of Warranty:**

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	12 months from the date of dispatch or as indicated in the RFQ	Not agreed.	6%
		Less than 12 months or as indicated in the RFQ	0.5 % per month for the difference in period

**TECHNICAL BID (TO BE ENCLOSED WITH TECHNO-COMMERCIAL BID)**

**(for Foreign Purchase Orders)**

Sl. No.	Particulars	Bidder's confirmation
1	<b>Price basis:</b> Firm i.e., from the date of PO to completion of supply [Price Variation Clause (PVC) not acceptable]	Acceptable / Not acceptable
2	<b>Terms of Payment:</b> Against "SIGHT DRAFT" on presentation of documents to our bankers. (a) 90 % is payable on negotiation of complete set of original documents & balance 10% against submission of PBG (where commissioning is NOT involved). (b) 75 % is payable on negotiation of complete set of original documents, 15% after satisfactory commissioning & balance 10% against submission of PBG (wherever commissioning & PBG is involved). (c) Deviation if any please specify Note: Refer <b>clause 12 above</b> .	(a) Acceptable / Not acceptable  (b) Acceptable / Not acceptable  (c)
3	<b>BHEL's penalty clause:</b> (a) Delay in delivery as per PO delivery date will result in penalty of 0.5 % per week subject to maximum of 10% on the value of the items not supplier/delayed. (b) Deviation if any Please specify	(a) Acceptable / Not acceptable  (b)
4	<b>Performance Bank guarantee:</b> PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format as detailed in <b>clause 15</b> .	Yes / No
5	<b>Terms of delivery:</b> (a) F.O.B international Airport/Seaport as <b>per clause 17</b> Indicate name of International Airport/Seaport (b) Deviation if any Please specify	(a)Acceptable / Not acceptable  (b)
6	<b>Warranty:</b> (a) 12 months from the date of dispatch (b) Deviation if any Please specify	(a)Acceptable / Not acceptable  (b)
7	<b>Delivery period:</b> Indicate number of weeks from the date of issue of Purchase order	_____Weeks
8	<b>Validity:</b> (a) Quotation should remain valid for a period of 90 days from the due date (b) Deviation if any Please specify	(a) Acceptable / Not acceptable  (b)

Signature of renderer / with seal

ANNEXURE - B

**TECHNICAL BID (TO BE ENCLOSED WITH TECHNO-COMMERCIAL BID)**

**(For Indigenous Purchase Orders)**

Sl. No.	Particulars	Bidder's confirmation
1	<b>Price basis:</b> Firm i.e., from the date of PO to completion of supply [Price Variation Clause (PVC) not acceptable]	Acceptable / Not acceptable
2	<b>Excise duty:</b> If applicable indicate %.	Applicable / Not applicable ED:_____%
3	<b>Sale tax:</b> If applicable indicate %	Applicable / Not applicable (a) VAT_____ % (b) CST_____ % against form C
4	<b>Payment terms:</b> (a) 90 % basic + 100% taxes, duties & freight charges within 30 days from the date of receipt & balance 10% against submission of PBG ( where commissioning is NOT involved)  (b) 75 % basic + 100% taxes, duties & freight charges within 30 days from the date of receipt, 15% after satisfactory commissioning & balance 10% against submission of PBG (wherever commissioning & PBG is involved).  (c) Deviation if any please specify Note: <b>As per clause 12</b>	(a) Acceptable / Not acceptable  (b) Acceptable / Not acceptable  (c)
5	<b>BHEL's penalty clause:</b> (a) Delay in delivery as per PO delivery date will result in penalty of 0.5 % per week subject to maximum of 10% on the value of the items not supplier/delayed. (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)
6	<b>Performance Bank guarantee (PBG):</b> PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format as per <b>clause 15</b> .	Yes / No
7	<b>Terms of delivery:</b> (a) Ex EDN / BHEL, Bangalore (Free delivery to EDN/BHEL Bangalore including packing & forwarding charges) (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
8	<b>Warranty:</b> (a) 18 months from the date of dispatch or 12 months from the date of commissioning (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
9	<b>Delivery period:</b> Indicate number of weeks from the date of issue of Purchase order	_____Weeks
10	<b>Validity:</b> (a) Quotation should remain valid for a period of 90 days from the due date (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)

Signature of renderer / with stamp

ANNEXURE - C

LIST OF INTERNATIONAL AIRPORTS

Sl. No	Country	Air Ports
1	Austria	Vienna, Linz, Graz
2	Australia	Sydney, Melbourne, Perth
3	Belgium	Antwerp, Brussels
4	Canada	Toronto, Montreal
5	China	Shangai
6	Cyprus	Lamaca
7	Czech Republic	Prague (Via Frankfurt)
8	Denmark	Copenhagen
9	Egypt	Cairo
10	Finland	Helsinki
11	France	Paris (Rossy), Lyon
12	Germany	Darmstadt, Manihem, Nurnberg, Hamburg, Stuttgart, Munich, Koln, Dusseldorf & Hannover, Frankfurt, Berlin
13	Hongkong	Hongkong
14	Italy	Rome, Milan, Turin, Bologna, Florence
15	Ireland	Dublin
16	Isrel	Telaviv
17	Japan	Tokyo, Osaka
18	Malaysia	Kaulalampur, Penang
19	Neatherlands	Amsterdam, Rotterdam
20	Newzealand	Auckland
21	Norway	Oslo
22	Oman	Muscat
23	Philiphines	Manila
24	Romania	Bucharest
25	Russia	Moscow
26	Saudi Arabia	Riyad
27	Singapore	Singapore
28	Slovakia	Bartislowa
29	South Africa	Johannesburg, Durban
30	South korea	Kimpo
31	Spain	Barcelona
32	Sweden	Stockholm, Gothenburg, Milano
33	Switzerland	Basle, Zurich, Geneva
34	Taiwan	Taipei
35	U.A.E.	Dubai
36	U.K.	Landon (Heathrow), Newcastle, Oxford, Cheltham, Bristol, Wellingborough, Birmingham, East Midland, Manchester, Leeds, Glasgow.
37	U.S.A.	Newyork, Chicago, Sanfrancisco, Los Angeles, Atlanta
38	Ukraine	Kiev

PERFORMANCE BANK GUARANTEE  
(FOR FOREIGN PURCHASE ORDERS)

BANK NAME AND ADDRESS

Bharat Heavy Electricals Limited (BHEL),  
Electronics Division,  
PB No. 2606,  
Mysore Road,  
BANGALORE- 560 026  
INDIA

Dear Sir,

Ref: CONTRACT PERFORMANCE GUARANTEE.

WHEREAS you have entered into a contract reference No PO NO. \_\_\_\_\_ 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% ( Ten Percent ) of \_\_\_\_\_ the contract price amounting to \_\_\_\_\_ ( \_\_\_\_\_ ) to secure its obligations 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 event 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:

- 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 alterations 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 render 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

Note:

- (1) To be executed in INR 100 Non-Judicial stamp paper by any authorized Indian Bank.
- (2) To be submitted directly by banker to concerned executive in purchase dept., Please give BHEL address to banker.
- (3) Do not enclose with Bank document.
- (4) Any Modification & omissions to this are not permitted

ANNEXURE - E

**PERFORMANCE BANK GUARANTEE**  
**(FOR INDEGENOUS PURCHASE ORDERS)**

THIS DEED OF GUARANTEE made and executed on the \_\_\_\_\_ day of \_\_\_\_\_(year), by the \_\_\_\_\_ (Bank), registered under the Companies Act 1956/Nationalised Bank constituted under the Banking Companies (acquisition and transfer of undertakings) Act constituted under the State Bank of India Act / Subsidiary Banks Act, having its registered / head office at \_\_\_\_\_ represented herein by its Branch Manager / authorised representative Sri. \_\_\_\_\_ & Sri. \_\_\_\_\_(Hereinafter called 'guarantor ' which term shall mean and include its successors and assigns)

IN FAVOUR OF BHARAT HEAVY ELECTRICALS LIMITED

\_\_\_\_\_ (Buyer's Name), a company registered under the companies Act, 1956 having its registered office at BHEL House at Siri Fort , New Delhi-100 049 and its Electronics Division at Mysore road, Bangalore-26 (hereinafter referred to as the 'Company' Which term shall include its successors and assigns):

Whereas the company has placed an order on \_\_\_\_\_ (State the name of the company / firm and its address) (hereinafter referred to as the 'Supplier' which term shall mean and include its liquidators, successors and assign) for the supply of system under order / Contract No \_\_\_\_\_ Dt \_\_\_\_\_.

AND WHEREAS the supplier has agreed to supply the materials and carryout the works as detailed and in accordance with the terms set out in the said order/contract.

AND WHEREAS the company is not required to pay to the supplier a sum of Rupees \_\_\_\_\_being the 10% of the value of the goods supplied / Works performed / Services rendered under the said order / contract between the supplier and the company, till the company is satisfied with the mechanical Warranties and the performance standards stipulated in the said order / contract between the company and the supplier has been duly fulfilled, except against a Bank Guarantee for the said sum of Rs \_\_\_\_\_ in favour of the company by reputed Bank, in which case the company has agreed to make payment to the supplier of the said sum of Rupees \_\_\_\_\_ being ( ...% ) of the value of the goods supplied / Works performed / Services rendered under the agreement between the supplier and the company and the Guarantor has at the request of the supplier, agreed to furnish this Guarantee subject to the terms and conditions stated below:

NOW THIS DEED WITNESSES THAT IN pursuance of the above said agreement, the guarantor hereby agrees and covenants With company is as follows :-

- 1) That during the period this contract of Guarantee remains effectual, the guarantor shall be liable in respect of the amount due and owing to the company in respect of the payments to the extent of Rs \_\_\_\_\_ (in words) \_\_\_\_\_ against any loss or damage caused to or suffered by the company by reasons of any breach of the terms of the said order / contract / Agreement by the supplier.
- 2) The Guarantor hereby undertakes to pay the amounts due and payable under this guarantee without any demur, merely on demand from the company intimating that the amount claimed is due by way of loss or damage caused to or suffered or would be caused or suffered by the supplier of any terms contained in the said order / contract. Any such demand made on the guarantor shall be conclusive as regards the amount due and payable by the Guarantor irrespective of the fact whether the Contractor / supplier admits or denies.

- 3) The Guarantor further agrees that the agreement herein contained shall remain in force and effect till all the supplies to be made / Works to be performed / Services to be rendered under the said order / contract / agreement are completed to the entire satisfaction of the company or till company certifies that the terms and conditions of the said order / contract / agreement have been fully and properly carried out by the said supplier and accordingly discharges the Guarantee. Unless a demand or claim under this guarantee is made on the guarantor in writing on or before the expiry of claim period indicated in clause 6 below , the guarantor shall be discharged from all the liability under this guarantee thereafter.
- 4) The guarantor further agrees with the company that the company shall have the fullest liberty without the consent of the guarantor and without effecting in any manner the obligations of the guarantor hereunder to vary any of the terms of the said order / contract / agreement or extend the time of performance by the said supplier from time to time or refrain from exercising the power exercisable by the company against the said supplier or to forebear or omit to enforce any of the terms and conditions relating to the said order / contract / agreement, and the guarantor shall not be relieved of its liability in whole or in part , by reason of any act, commission or forbearance on the part of the company or by reason of any such variation, or extension being granted to the said supplier or by reason of any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving the guarantor.
- 5) The guarantor undertakes not to revoke this guarantee during its currency except with the previous consent of the company in writing.
- 6) Notwithstanding anything herein above contained, the liability of the guarantor under these presents is restricted to Rs\_\_\_\_\_. The guarantee shall be in force till its expiry on \_\_\_\_\_ unless a demand is made on the guarantor within SIX months from the date of expiry, all the liability of the guarantor under this guarantee shall stand fully discharged. The decision of the claimant in regard to breach of contract is final and binding on the Bank.

IN WITNESS whereof, the guarantor, acting through its authorised representative has executed this deed of Guarantee on the day, month and year first above written.

(Seal of the Bank to be affixed )

WITNESS

1.

2.

ANNEXURE - F

**BHEL MEMBER BANKS**

**PBG SHALL BE ISSUED FROM THE FOLLOWING BANKS OR THEIR BRANCH OFFICES ONLY**

State Bank of India, CAG Branch 10 <sup>th</sup> Floor, Vijaya Building Barakamba Road, NEW DELHI - 110 001	Deutsche Bank, Tolstoy Marg, NEW DELHI - 110 001
Canara Bank, 74, Janpath, NEW DELHI - 110 001	HDFC Bank Ltd, 5 <sup>TH</sup> 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, Corporation Banking Branch, 11 <sup>th</sup> 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
State \Bank of Mysore, Antrikash Bhawan, K G Marg, NEW DELHI - 110 001	IDBI Bank Ltd, 19 K G Marg, Surya Kiran Building, NEW DELHI - 110 001
State Bank of Mysore, Industrial Finance Branch, 18, Ramanashree Arcade,, M G Road, BANGALORE 0 560 001	HSBC Ltd, ECE House, 28K G Marg, NEW DELHI - 110 001
State Bank of Travancore, Travancore House, IF Branch, NEW DELHI - 110 001	

\*\*\*