भारत सरकार - रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
मानक नगर, लखनऊ- 226 011

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संख्या/No. RDSO-TI0LKO(PSI)/19/2020-O/o PED/TI/RDSO **दिनांक/Date: As signed.**

1.	M/s Meiden T&D (India) Limited, SEZ, Menakuru, SPSR Nellore District, Naidupeta Andhra Pradesh – 524126	gagandeep.tandon@meiden.in
2.	M/s Toshiba Transmission & Distribution Systems (India) limited, 1104, Surya Kiran building, 19, K. G. Marg, Cannaught Place, New Delhi-110001	rajib.chaudhary@toshiba-ttdi.com
3.	M/s Hitachi Energy India Limited Power Transformer Factory, Maneja Works Vadodara, Gujarat - 390013, India	sukhamnder.singh@hitachienergy.com, shailendra.p.sing@hitachienergy.com
4.	M/s CG Power and Industrial Solutions Ltd., Power Transformer Division T-3 29, 31-32 New Industrial Area, Mandideep Raisen, Madhya Pradesh - 462046, India,	akhilesh.gupta@cgglobal.com, nidhi.tiwary@@cgglobal.com,
5.	M/s Kanohar Electricals Limited, Rithani, Delhi Road, Meerut-250103	jagbir.singh@kanohar.com
6.	M/s Bharat Heavy Electricals Limited, P. O. BHEL, Jhansi (UP)-284129	rodbhellko@hotmail.com
7.	M/s Siemens Limited, Plot No.-78, JIL Jagatjit Industrial limited, Shaheed RIPON, Katyal marg sector, Gurugram Haryana -122015	debraj.choudhary@siemens.com
8.	M/s Vishvas Power Engg. Services Pvt. Ltd., Plot No. K-5, Five Star Industrial Area MIDC, Butibori, Nagpur Nagpur, Maharashtra - 441122, India	vishvaspowercmc@gmail.com
9.	M/s High – Volt Electricals Pvt. Limited, J-46 /J-47, MIDC Tarapur Industrial Area, Boisar, Distt. Palghar, Maharashtra – 401506	viraldesai@highvolt.in
10.	M /s TMC Transformers India Private Limited, Sur.No.26 1/2, Part B, Village Khandiwada (ASOJ), Vadodara-Halol Highway VADODARA,Gujarat - 391510	tkmohan@tmc-india.com
11.	M/s Shree Abirami Enggineering Works Private Limited, SAEW Unit-2, Survey No 22/1 & 22/2, Sriperumbudur Kodambakkam High Road, Kanchipuram, Tamil Nadu -602105,	md@abiramiengg.com
12.	M/s Technical Associates Limited, B-7 Eldeco Sidcul Industrial Park Sitarganj U.S. Nagar Uttarakhand Sitarganj, Uttarakhand - 262405, India	eproc@techasso.com
13.	M/s Transformers & Rectifiers India Limited, Survey No. 427 P/3-4 and 431 P/1-2, Sarkhej- Bavla Highway, Village Moraiya, Taluka Sanand, Dist. Ahmedabad Gujarat - 382213, India	Siddharth.dixit@transformerindia.com

विषय/Sub: Standard of Transformer Oil to be used in Traction Transformers of Indian Railways.

संदर्भ/Ref: (i) This office letters of even no. dated 02.12.2024 & 13.12.2024.
(ii) Core letter no. CORE-HQ0ELEC(MP)/4/2022-O/o CAO/CORE/PRYJJ dated 14.11.2024.

*****

Vide letters referred above, it was advised to refer the Standard of Transformer Oil to be used in Traction Transformers as 'Type A of IEC: 60296', appearing in the **CLW vendor directory** with **item ID**: **2100653**. Accordingly, the vendors appearing in the CLW Vendor Directory against this item, are to be referred for the sources of Transformer Oil.

2. Further, following A&C slips of the respective specifications of the Transformers w.r.t. change in standard of Inhibited Mineral Insulating Oil, are also enclosed herewith, for reference.

SN	Specification No.	Description of Specification	A&C Slip No.
i.	TI/SPC/PSI/AUTOTR/1200	Specification for 8 MVA, 12.5MVA & 16.5MVA 55kV/27.5kV Autotransformer	A&C slip No. 01
ii.	TI/SPC/PSI/TRNPWR/4200	Specification for 21.6MVA & 38/53/63MVA Single Phase Dual LV Winding Traction Power Transformer	A&C slip No. 01
iii.	TI/SPC/PSI/TRNPWR/ 5200	Specification for 54MVA & 60/84/100MVA Scott	A&C slip No. 02

	with A&C slip No. 01	Connected Traction Power Transformer	
iv.	TI/SPC/PSI/TRNPWR/3201	Specification for 13.5/18.9 MVA, 21.6/30.24 MVA, 30/42MVA & 40/56 MVA Single Phase Traction Power Transformer	A&C slip No. 01
v.	TI/SPC/PSI/AUTOTR/0091	Specification for 50/75/150 MVA, ONAN/ONAF/ OFAF, 220/ 132 kV, 3-Phase Oil Immersed Type Auto Transformer.	A&C slip No. 01
vi.	TI/SPC/PSI/CT/0210	Specification for Current Transformers for Railway AC Traction Substation	A&C slip No. 01
vii.	TI/SPC/PSI/PT/0210	Specification For 220kV or 132kV or 110kV or 66kV or 25kV Potential Transformer	A&C slip No. 01
viii.	ETI/PSI/15	Specification For 5kVA, 10kVA, 25kVA & 50kVA Auxiliary Transformer.	A&C slip No. 01
ix.	ETI/PSI/15A with A&C slip No. 01	Specification For 100kVA Auxiliary Transformer.	A&C slip No. 02

2. This is for your information and further necessary action at your end, please.

This is issued with the approval of the Competent Authority (PED/TI).

Digitally Signed by
Jitendra Kumar
Date: 30-12-2024 17:42:21
Reason: Approved

(Jitendra Kumar)
Director/TI-3
For Director General (TI)

संलग्नक: As stated above.

Copy to:

The Principal Chief Electrical Engineer,

- **i.** Central Railway, Statin Building, Mumbai CST – 400 001.
- **ii.** Eastern Railway, Fairlie Place, Kilkata-700 001.
- **iii.** East Central Railway, Hajipur-844 101.
- **iv.** East Coast Railway, hubaneshwar-751 023.
- **v.** Northern Railway, Baroda House, New Delhi - 110 001.
- **vi.** North Central Railway, Prayagraj-211 015.
- **vii.** North Eastern Railway, Gorakhpur-273 012.
- **viii.** North Frontier Railway, Mailgaon - 781 011.
- **ix.** North Western Railway, Jaipur – 302 017.
- **x.** Southern Railway, Park Town, Chennai- 600 003.
- **xi.** South Central Railway, Railnilayam, Secunderabad-500 371.
- **xii.** South Eastern Railway, Garden Reach, Kilkata-700 043.
- **xiii.** South East Central, Railway, ilaspur-495 004.
- **xiv.** South West Railway, DRM's Office, Hubli-580 028.
- **xv.** Western Railway, Churchgate, Mumbai-400 020.
- **xvi.** West Central Railway, Jabalpur- 482 001.
- **xvii.** Konkan Railway, Belapur Bhavan, Sectir-11, CBD Belapur, Navi Mumbai 400614.

2. Chief Administrative Officer, CORE, Prayagraj-211001, e-mail: ceehq.core@gmail.com

Addendum & Corrigendum Slip No. 01 to the RDSO's Specification No. Technical TI/SPC/PSI/CT/0210 (06/2021) for Current Transformers for Railway AC Traction Substation.

*****

1. Standard of Insulating Oil mentioned as "IS 335:2018" at Para No. 2.1-1, 6.5, 14.4.4 and Para No. 4.11 of Annexure-VIII, is replaced with "IEC: 60296 (Type A)".

2. In Para No. 4.11 of Annexure-VIII mentioned "The Insulating Oil shall be procured from the manufacturers approved by RDSO" is replaced with "For the sources of Insulating Oil, refer CLW Vendor Directory (item ID: 2100653) available on IREPS website".

3. In Para No. 14.4.4, mentioned "or as per IEC 60296" is deleted and new line is added as "For the sources of Insulating Oil, refer CLW Vendor Directory (item ID: 2100653) available on IREPS website."

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30/12/2024	30/12/24	30/12/24
(Pramod Sahu)	(Ramesh Kumar Pal)	(Jitendra Kumar)
SSE/TI	ADE/TI-3	DTI-3

Specification No. TI/SPC/PSI/CT/0210(07/2021)

GOVERNMENT OF INDIA

सत्यमेव जयते

MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION

FOR

CURRENT TRANSFORMERs WITH CT RATIO OF

220 kV, 400-200/5A & 200-100/5A

132 kV, 800-400/5A & 400-200/5A

110kV, 800-400/5A & 400-200/5A

66kV, 1200-600/5A & 800-400/5A

50kV, 1500-750/5A & 200/5A

25kV, 3000-1500/5A, 1600-800-400/5A, 1500-750/5A, 1000-500/5A, 400-200/5A & 100-50/5A

11kV, 500/5A

FOR

RAILWAY AC TRACTION SUBSTATION.

	Prepared by	Checked by	Approved by
Signature			
Date	21.06.21	21/06/21	21/6/21
Designation	SSE/TI	DTI-3	EDTI

Issued by

Traction Installation Directorate

RESEARCH DESIGNS AND STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW-226011.

July 2021

SPECIFICATION FOR CURRENT TRANSFORMERs

1.0 SCOPE

1.1 This specification covers the design and testing of outdoor type Current Transformer (CT) for a nominal System voltage of 220/132/110/66/50/25/11 kV for installation in Railway's traction sub-station in any part of India for operation of protective devices and indicating instruments, for shunt capacitor banks etc.

1.2 The CT shall be complete with all parts, fittings and accessories necessary for its efficient operation. All such parts, fittings and accessories shall be deemed to be within the scope of this specification, whether specifically mentioned or not.

1.3 Additional details of 132 kV current transformer to be used in Mumbai Area are given in Annexure-VIII

1.4 The specification supersedes the earlier specification No. ETI/PSI/36(05/75), ETI/PSI/90(06/95), ETI/PSI/117(7/88), ETI/PSI/145(03/92) & ETI/PSI/147(03/92).

1.5 The 'Make in India' policy of 'Government of India' shall be applicable

2.0 GOVERNING SPECIFICATION

2.1 The CT shall, unless otherwise specified conform to the following standards and codes of practices (latest version) which shall be applied in the manner altered, amended or supplemented by this specification and Indian Electricity Rules, wherever applicable.

1	IS 335 : 2018	New insulating oils - specification
2	IS: 1367	Technical supply conditions for threaded steel fasteners.
~~3~~	IS:1554 (Part I) (REAFFIRMED 2015)	Specification for PVC insulated (Heavy duty), electrical cables for working voltage up to and including 1100 volts.
4	IS:1570 (Part V) (REAFFIRMED 2018)	Schedule for wrought steel for general engineering purposes.
5	ISO/EN 12944	Protective Paint System
6	IS:2074 PART 1 : 2015	Ready mixed paint, air drying red oxide zinc chrome, priming.
7	IS:2705: Part 1 (REAFFIRMED 2017)	Current Transformers: Part 1 General Requirements
8	IS:2927 (REAFFIRMED 2019)	Brazing alloys.
9	IS: 3024	Grain oriented electrical steel sheet and strip
10	IS:4253(Part II) (REAFFIRMED 2019)	Cork and rubber.
11	IS:5561	Specification for Electric power connectors.
12	IS:5621	Specification for hollow insulators for use in electrical equipment.
13	IS: 8570 (REAFFIRMED 2016)	Press paper for electrical purposes.
14	IS:8572 (REAFFIRMED 2018)	Paper covered flexible/ stranded copper conductor for transformer leads.
15	IS: 10026 (Part I to III	Code of practice for selection, installation and maintenance of transformers.
16	IS:16227 PART 1 : 2016	Instrument Transformers - Part 1 General Requirements
17	IS:16227 PART 2 : 2016	Additional Requirements for Current Transformers
18	IS/IEC: 60137:2017	Bushing for alternating voltage above 1000 V.
19	IS/IEC 62155:2003	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V

2.2 In case of any conflict between the contents of the above specifications and this specification, the latter shall prevail.

2.3 Any deviation from this specification, proposed by the firm, intended to improve the performance, utility and efficiency of the equipment, will be given due consideration provided full particulars of the deviation with justification therefor are furnished. In such cases, the firm shall quote according to this specification and the deviation, if any, proposed by him shall be quoted as an alternative(s).

3.0 ENVIRONMENTAL CONDITIONS.

3.1 The CT shall be suitable for outdoor use in moist tropical climate and in areas subject to heavy rainfall. Pollution due to industry and marine atmosphere and severe lightning. The limiting weather conditions which the transformer has to withstand in service are indicated below:

i.	Maximum ambient air temperature	:	50^0 C
ii.	Minimum Temperature of Air in shade	:	(-)10^0 C
iii.	Average ambient air temperature over a period of 24 hrs.	:	35° C
iv.	Maximum Relative Humidity	:	100%
v.	Annual Rainfall ranging from	:	1750 mm to 6250 mm
vi.	Maximum Number of Thunder storm days per annum	:	85 days
vii.	Maximum number of Dust Storm days per annum	:	35 days
viii.	Number of Rainy days per Annum	:	120 days
ix.	Basic Wind Pressure	:	216 kgf/m2
x.	Altitude above Mean Sea Level	:	Normally 1000 meters but some of the places it may be up to 2500 meter

Note:

i. The above parameters are for normally 1000 meters altitude; however these details will be changed for altitude above 1000 meters and up to 2500 meter. These details shall be supplied by Railways.

ii. The BIL shall be changed as per IEC-60071 & IEC-62271-1, for altitude above 1000 meter and up to 2500 meter.

3.2 The CT is also subjected to vibrations on account of trains running on nearby railway track. The amplitude of these vibrations which occur with rapidly varying time periods in the range of 15 ms to 70 ms lies in the range of 30 micron at present with the instantaneous peak going up to 150 micron. These vibrations may become more severe as the speeds and loads of trains increase in future.

4.0 TRACTION POWER SUPPLY SYSTEM.

4.1 GENERAL SCHEME OF 25KV CONVENTIONAL SYSTEM

4.1.1 Power is received from the grid network of the State Electricity Board/TATA Power at 220 kV/ 132 kV/110 kV/66 kV, 3-phase grid system through a step down transformer, either at individual traction substation (TSS) or at a single point of supply from where it is transmitted through railway's own transmission lines, to the traction substations, with line sectioning facilities provided as required. 25 kV power supply for traction is drawn through a single phase step down traction transformer. The primary winding of this transformer is connected to any two nominated phases of the incoming three phase lines or to the two incoming phase lines and on the secondary side, either of the two terminals of the 25 kV winding is connected to the traction overhead equipment, while the other is solidly earthed and connected to the running traction rails.

4.1.2 The incoming 220/132/110/66 kV supply voltage may vary between +10% and -12.5% as per IE Rule No. 54.

4.1.3 The current transformer of 220/132/110/66 kV rating shall be on the primary side of the single phase power transformer for use with the following electrical measuring/indicating instruments/meters and protective devices/relay:-

i. Instantaneous Over current relay

ii. Inverse Definite Minimum time lag over current relay
iii. Restricted earth fault-relay

Operation of any of the protective devices/relays which serve as the backup protective system for that on the 25 kV side of the traction power transformer shall trip the circuit breaker on the primary side of the transformer.

4.1.4 Each transformer has its associated circuit breakers on the primary and secondary sides, with a separate set of 25 kV circuit breakers called "feeder Circuit Breakers" for feeding the traction overhead equipment (OHE) lines.

4.1.5 Adjacent TSS is fed from different phases of the three phase system in rotation. Neutral sections in front of sectioning and paralleling post (SP) are provided in the 25 kV OHE for segregating the different phases. In between the TSS and SP, sub sectioning and paralleling post (SSP) are provided for paralleling the up and down line OHE and also for sectionalising and fault localisation. The attached sketch No. ETI/PSI/702-1 MOD -'C' at Annexure-1 shows the general scheme for traction power supply system.

4.1.6 The supply to the OHE can be switched on/off through interrupters which do not open automatically on fault, but can be closed on to a fault. The fault is cleared by the feeder circuit breaker provided at the traction substation.

4.1.7 Normally power supply from a TSS extends up to the SP on either side of the substation, but in case of an emergency necessitating total shut down of the substation; power supply from the adjacent TSS on either side of the failed substation can be extended up to the failed substation by closing the bridging interrupters at the two SPs.

4.1.8 The scheme of protection to be provided at each of the traction sub-station comprises of the following three systems.

i) Protection of the 220/27 kV or 132/27 kV or 110/27 kV or 66/27 kV traction transformer installed at the traction sub-station.
ii) Protection of the 25 kV overhead equipment
iii) Protection of 220/132/110/66 kV transmission lines.

4.1.9 The relays for transformer protection as well as feeder protection shall be suitable for operating from current transformer. A schematic diagram showing the protection scheme is given at Annexure-II. The following relays shall be fed by the CT.

a) Relays/ instruments fed by feeder protection CTs.
   i. Distant protection relay (polygonal)
   ii. Wrong phase coupling relay (polygonal)
   iii. Instantaneous over current relay.
   iv. Transducer for telemetry of feeder current
   v. Transducer for telemetry of MVA (maximum demand)
   vi. Transducer for telemetry of power factor.
   vii. Restricted earth fault relay.
   viii. Thermal over-current relay.
   ix. Ammeter.

b) Relays/ instruments fed by transformer protection CT
   i. IDMT over current relay.
   ii. Restricted earth fault relay.
   iii. Ammeter

4.2 <u>GENERAL SCHEME OF 2X 25 KV AT FEEDING SYSTEM</u>

The electrical power for railway traction is supplied in AC 50 Hz. Single phase through 2x 25 kV AT feeding system. This has a feeding voltage from the sub-station two times as high (2x 25 kV) as catenary voltage (25 kV). This high voltage power supplied from the traction sub-station

through catenary wire and feeder wire is stepped down to the catenary voltage by use of autotransformers installed about every 13 to 17 km along the track, and then fed to the locomotives. In other words, both the catenary voltage and feeder voltage are 25 kV against the rail, although the sub-station feeding voltage between catenary and feeder is 50 kV. Therefore the catenary voltage is the same as that of the conventional 25 kV system.

A figure showing the principle of AT feeding system and a typical power supply diagram showing the general feeding arrangement at a traction sub-station and sections of the OHE are given in the sketch at the Annexure-I C.

4.2.1 Protection System

The following relays are provided for the protection of traction transformers:

a) Differential relay.
b) Overcurrent relay on 220 kV or 132 kV side.
c) Grounding overcurrent relay on 220 kV or 132 kV side.
d) High speed over current relay on 220 kV or 132 kV side.
e) Phase- failure relay (to detect a malfunction of a feeder circuit breaker)

4.2.2 The following relays are provided for the protection of OHE:

a) Distance relay (with a parallelogram protection characteristics.)
b) Delta I type fault selective relay.
c) Under voltage relay.
d) Instantaneous Over Current relay

4.2.3 25 kV OHE and Traction Transformer –Electric Parameters:

The OHE is made up of a stranded cadmium copper catenary of 65 sq. mm or a stranded aluminium alloy catenary of 116 sq. mm and a grooved contact wire of 107 sq. mm, making up a total of 150 sq.mm or 140 sq. mm copper equivalent, respectively. As a feeder wire, a stranded aluminium alloy of 240 sq. mm. is used.

4.2.4 Nature of Faults on the OHE System.

OHE (including a feeder wire) is subjected to frequent earth faults caused by failure of insulation, or by the OHE snapping and touching the rail or earth, or by a piece of wire dropped by birds connecting the OHE to earthed overline structures, miscreant activities etc. These faults are cleared by the feeder circuit breaker which operates on any one or both of the following relays.

a) Distance relay (with a parallelogram protection characteristics).
b) Delta-I type fault selective relay.

4.2.5 Short circuit apparent power of the system: The short circuit apparent power for various system voltages is as under:

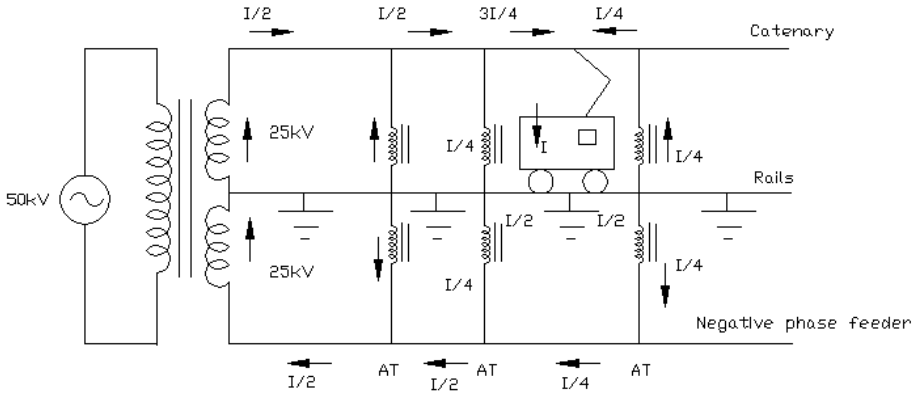
Highest system voltage kV/ rms	Short circuit apparent power MVA
52	200
72.5	3500
123	6000
145	10,000
245	20,000

4.3 BRIEF DESCRIPTION OF THE 2 X 25 KV NEW SYSTEMS

To up gradation of existing NDLS-HWH and DLI-KOTA-MUMBAI ROUTES for 160kmph, the 2X25 kV new system is preferred solution across the globe to cater the higher power requirement on high density routes.

In 2x25 kV system, power is fed from the TSS at 50 kV and utilization is achieved at 25 kV by providing Auto-transformers of adequate capacity and by providing one additional conductor normally referred as feeder wire (similar to the return conductor in BT/RC system). Centre point of the Auto Transformer is connected to the earth/rail. This arrangement facilitates +25 kV Voltage between OHE and rail and -25 kV voltage between Rail/earth and the Feeder Wire. A schematic diagram No.

TI/DRG/PSI/AT/00009/20/0 & TI/DRG/PSI/AT/RDSO/00034/20/0, showing the general arrangement at a TSS is at Annexure I-A & 1-B.



5.0 RATING AND GENERAL DATA

The CT shall be designed for the following rating and other particulars.

i)	Type	Single/Two core Oil filled, single phase, natural air cooled, low reactance, sealed, outdoor type.						
ii)	No. of windings	Primary – One/Two/Three Secondary - One						
iii)	Rated voltage, in kV	220	132	110	66	50	25 kV varying from 19.0 kV to 27.5 kV, sometimes touching 30 kV	11
iv)	Highest voltage for equipment, $U_{m,}$, in kV	245	145	123	72.5	72.5	52 kV	12
v)	Rated frequency	50 Hz+- 3%						
vi)	Rated primary current, in Amp.	400-200 or 200-100	1200-800-400 (for 30/42 MVA) Or 800-400 or 400-200	800-400 Or 400-200	1200-600 or 800-400	1500-750 or 200-100	3000-1500 1600-800-400, 1500-750, 1000-500, 400-200, 100-50	500
vii)	Rated secondary current.	5A						
viii)	Rated transformation ratio	400-200/5 Or 200-100/5	1200-800-400/5 Or 800-400/5 Or 400-200/5	800-400/5 Or 400-200/5	1200-600/5 or 800-400/5	1500-750/5 & 200-100/5	i) 3000-1500/5 ii) 1600-800-400/5 iii) 1500-750/5 iv) 1000-500/5 v) 400-200/5 vi) 100-50/5	500/5
ix)	Rated burden, in VA	30	30	30	30	30	60	30
x)	Accuracy class	5P	5P	5P	5P	5P	(i) 5P – for a) 1000-500/5A and b) 1500-750/5A (ii) PS – for 1500-750/5A (for Mumbai Area)	5P
xi)	Rated accuracy limit factor	15						

xii)	Rated short time thermal current.	31.5					25	25
xiii)	Rated dynamic current peak.	78.75					62.5	62.5
xiv)	Rated insulation level 1. Power frequency withstand voltage. kV (rms) for One minute duration 2. Impulse withstand voltage, kV peak.	460 1050	275 650	230 550	140 325	140 325	95 250	28 75
xv)	Resistance of secondary winding.	Not greater than values declared by manufacturer in SOGP					Not greater than 0.3 ohm at 75 deg C.	Not greater than 0.25 ohm at 75 deg C.
xvi)	Class of insulation	Class 'A'						
xvii)	Temperature rise limits	See clause of testing					a) The temperature rise over an ambient temperature rise over an ambient temperature of 50 C shall not exceed the values indicated below: b) Windings-50 deg C (measured by resistance method.)\Insulating oil-40 C (measured by thermometer method). c) Current carrying parts in air: 40 deg C (measured by the thermometer.)	-
xviii)	Terminal bushing: 1. Voltage class and rated current. 2. Minimum creepage distance (in mm.) of the porcelain housing.	220kV, 800A 6125	132kV, 800A 3625	110kV, 800A 3075	66 kV, 1200A 1813	66kV, 1600A 1813	52 kV class, 3000 A (for 40/56 MVA) or 52 kV class, 2000 A. 1300	12 kV, 500A 300
xix)	Minimum knee point voltage (for PS class)	Not applicable					i) 210 Volts for any of the winding taps (1500-750/5A) ii) 360 Volts for two cores of PS class CTs	Not applicable
xx)	Maximum exciting current (for PS class)	Not applicable					500mA at rated knee point voltage	NA

Note: The BIL shall be changed as per IEC-60071 & IEC-62271-1, for altitude above 1000 meter and up to 2500 meter.

6.0 CONSTRUCTIONAL FEATURES

6.1 The CT shall have a single/two core with wound primary. The primary winding shall be split in two sections insulated from each other and connected to terminals P1, P2, C1 & C2. It shall be possible to change the transformation ratio by connecting C1 with C2 for series configuration or P1 with C1

& P2 with C2 for parallel configuration. For connecting these terminals in series or parallel configuration, suitable links of adequate section made of copper flat shall be provided. The nuts and checkouts used for connecting these links shall be made of copper. Alternatively tapings on the secondary windings may be offered to give the specified transformation ratios. In this case suitable shorting link of adequate section made of copper shall be provided. Only copper conductors shall be used for primary and secondary windings.

6.2 The core shall be built up of high permeability, low loss; cold rolled grain oriented, non-aging, electrical silicon steel laminations conforming to IS: 3024. The laminations shall be coated on both sides with suitable insulation capable of withstanding stress relief annealing. The laminations for the core shall be free from waves, deformations and signs of rust. In assembling the core, care shall be taken to ensure that no air gaps are formed.

6.3 Each of the core clamping bolts and the core clamping frame work shall be insulated from the core laminations and tested after completion of the core assembly to ensure that they withstand a voltage of 2 kV rms with respect to core for duration of 60 s.

6.4 The CT shall be of sealed construction with nitrogen gas above the insulating oil and shall be adequately protected against any leakage of nitrogen gas or oil and ingress of moisture. All joints in the construction of the CT shall be suitably sealed so as to provide lasting gas, air, oil and water tightness. The number of gasketed joints shall be restricted to the minimum.

6.5 The CT core and windings shall be dried under vacuum till appropriate values of insulation resistance and power factor have been obtained. It shall then be filled up under vacuum with transformer insulating oil conforming to IS: 335. The characteristics of parameters as stipulated in IS: 335. (Inhibited Insulation Oil as per IEC 60296 with Pour Point:-40°C should be used in case of installation altitude is above 1000 meter and up to 2500 meter)

6.6 The HT terminal of the CT shall be located below the minimum oil level as marked on the oil level gauge mounted on the oil expansion chamber.

6.7 A port shall be provided on the oil expansion chamber to serve the purpose of oil filing and also for fixing the nitrogen gas filling assembly. The nitrogen gas filling assembly shall be screwed into the oil filling port and shall have its own leak proof sealing. A screwed cap shall be provided on the oil filling port with a gasket or 'D' ring provided at suitable location. The internal and external threads provided on the oil filing port shall be of adequate length and shall confirm to the precision grade' as defined in IS: 1367.

6.8 The oil draining pipe provided on the bottom tank shall have suitable internal threads over an adequate length and threaded plug should be screwed into the pipe. The assembly of the threaded pipe and the plug shall conform to the 'precision grade' as defined in IS: 1367. In addition, a gasket or 'O' ring shall be provided at suitable location in the assembly.

6.9 The CT secondary terminals shall be housed in a weather proof terminal box fitted with a cable gland suitable for 4 mm , 2 core, PVC insulated and PVC sheathed copper cable of 1100 volt grade, con forming to IS: 1554 (Part I) .

6.10 Facilities for short circuiting the secondary terminals shall be provided within the terminal box. An earthing link shall be provided in the terminal box to enable earthing of one end of the secondary winding. The CT shall also be provided with a standard 10 A test winding for rating of 66kV or above.

6.11 Normally, no joint shall be used in the winding conductor. If a joint becomes inescapable, it shall be brazed with high silver alloy grade BA Cu Ag 6 conforming to IS: 2927 or electrically butt-welded.

6.12 No grading rings shall be used in the construction of the CT.

6.13 All leads and connections shall be mechanically strong, adequately insulated, protected against mechanical injury and rigidly clamped to withstand dynamic stresses due to short circuits.

6.14 All the bolted mechanical and electrical connections in the assembly of CT shall be provided with standard locking arrangements to prevent their becoming loose in service due to vibrations etc.

6.15 Alternatively, a fully hermetically sealed CT may be offered. In this case a stainless steel bellow shall be provided at the top of oil, to take care of expansion/ contraction of oil due to thermal variations. As the oil will not come in contact with air during the service life of CT, there may not be any necessity to provide Nitrogen gas cushion at the top of oil. However, the detailed design/drawing for the same shall be submitted along with complete technical details to assess the suitability of the design being offered.

7.0 BUSHINGS AND TERMINAL CONNECTORS

7.1 Outdoor type bushing shall conforming to IS/IEC: 62155. The basic insulation level shall have the appropriate value as mentioned under table of Para 5.0 of this specification. The porcelain housing shall be capable of withstanding all electrical and mechanical stress that might be produced during the operation of the current transformer under normal and short-circuit conditions.

7.2 The porcelain housing shall be of a single piece construction i.e. there shall be no joint in the porcelain. The shed profile shall have a lip at the extremities, but free from ribs on the underside so as to avoid accumulation of dust and pollutants and to permit easy cleaning.

7.3 The design of the bushing shall be such that stresses due to expansion and contraction in any part of the bushing shall not lead to its deterioration/breakage.

7.4 The porcelain housing to be used, shall conform to IEC: 62155 and shall withstand the following test voltages as mentioned under table of Para 5.0:

1. Rated short duration wet power frequency withstand voltage.
2. Rated lightening impulse withstand voltage peak

7.5 The CT terminals and terminals fittings shall be capable of carrying the rated current continuously without exceeding the temperature rise limits of any part. They shall be free from corona and shall not cause radio interference.

7.6 The bushing/housing terminals to be provided at 220/132/110/66/50 kV side shall be suitable for connection to 'ZEBRA' 28.62 mm. ACSR conductor. The design shall be such so as to be connected to the equipment terminal pad with a minimum of four 12 mm. dia bolts nuts and lock nuts which shall be of Stainless steel. Each of these bolts shall also have a flat washer and spring washer.

7.7 For equipment earthing, the steel supporting frame shall be provided with two earthing terminals of adequate capacity to carry the rated short circuit current safely. The earthing terminal shall be connected to 50mm x 6mm M.S.Flat. The earthing terminal shall be provided with 17.5+0.5 mm dia. hole for fixing the earthing flat.

7.8 The bushing/housing terminals shall be provided with a rigid type terminal connector on one side and an expansion type terminal connector on the other side. These terminals, as per Research Designs and Standards Organisation (RDSO) drawings indicated below-shall be supplied along with each CT.

i) Expansion type terminal connector- Drg. No. ETI/PSI/P/11060 Mod 'E' (At Annexure III)
ii) Rigid type terminal connector- Drg. No. ETI/PSI/P/11090 Mod 'C' (At Annexure IV).
iii) Terminal Connector to Suit 'ZEBRA' ACSR conductor and 30 Dia Cu Stud of CT/CB/Traction Power Transformer - Drg. No. ETI/PSI/P/11010 Mod 'C' (At Annexure V)

These terminals shall be suitable for 50 mm diameter Aluminium tubular bus bar and for terminal pad of CT for horizontal take off.

7.9 The material of clamping rings/flanges used shall conform to MCI Grade BM-340 of IS: 2108 or to SGCI Grade: 400/12 of IS: 1865 or to Aluminium alloy Grade 4450 of IS: 617. The mass of zinc coating shall not be less than 1000 gm/m^2.

8.0 FASTENERS

8.1 All fasteners of 12 mm diameter and less. Exposed to atmosphere shall be of stainless steel and those above 12 mm diameter shall preferably be of stainless steel or of mild steel hot dip galvanised to 610/g/m^2 of zinc. The material of the stainless steel fasteners shall conform to IS: 1570 (Pt. V) grade 04, Cr 17 NI 12 MO2.

9.0 PAINTING

9.1 All the external steel surfaces of the current transformer exposed to atmosphere including main tank, secondary terminal box & top metallic should be hot dip galvanized for proper protection against corrosive and coastal environments.

10.0 SOURCE OF SUPPLY FOR WINDING WIRE, GASKETS & 'O' RINGS

10.1 Polyvinyl Acetyl enamel or polyester enamel wire shall be used for secondary winding. Wires, gaskets and 'O' rings certified only by Bureau of Indian Standards (BIS) shall be used in the manufacture of CT.

10.2 The successful firm/ manufacturer shall be required to furnish the following information with respect to the winding wires. Gaskets and 'O' rings:

i) Source of supply

ii) Reference to standard specification to which the material conforms.

iii) Reports of type tests carried out in terms of the relevant Indian Standard specification.

11.0 RATING PLATE.

11.1 The CT shall be provided with a rating plate (both in Hindi and English) of weather proof material, fitted in a visible position. The entries on the plate shall be indelibly marked by etching, engraving or stamping, the following items shall be shown on the rating plate

i) Type of transformer
ii) Governing specification.
iii) Manufacturer's name and country of origin.
iv) Manufacturer's serial number and type designation.
v) Year of manufacture
vi) Rated output and corresponding accuracy class.
vii) Rated frequency
viii) Highest voltage for equipment
ix) Rated current
x) Rated transformation ratio
xi) Maximum temperature rise over an ambient of 50 deg C.
    a) of oil
    b) of winding
xii) Total mass.
xiii) Rated insulation level
xiv) Connection diagram.

12.0 PARTS, FITTINGS AND ACCESSORIES

12.1 The following parts, fittings and accessories shall be supplied with each CT:

I. Rating and diagram plate.
II. Terminal marking plate.
III. Weather proof terminal box.
IV. Cable gland to take wire, 4 mm^2/1100 V grade PVC insulated, PVC sheathed unarmoured heavy duty copper cables to IS: 1554 (Part –I).
V. Lifting lugs.
VI. Two galvanised earthing terminals.
VII. Terminal connectors.
VIII. Plain rollers.

IX. Oil filling port and nitrogen gas filling valve.
X. Oil drain pipe with plug.
XI. Pressure relief device.
XII. Oil level sight gauge (tough acrylic plastic/ prismatic)
XIII. Adjustable arcing horns (if applicable)

12.2 The parts, fittings and accessories for the CT shall be only of those manufacturers approved by purchaser/ Vendor approving authority. If any items from fresh manufacturers/sources are proposed to be used, it shall have to be type tested in the presence of Vendor approving authority's representative and approval obtained before procuring the item for use.

13.0 DRAWINGS

13.1 The successful firm/ manufacturer shall submit for approval the following detailed dimensioned drawings to purchaser/Vendor approving authority as per Indian Railways standard in sizes of 210 mm x 297 mm or any integral multiples thereof:-

1. Outline general arrangement of the CT indicating plan, front elevation, side elevation with all parts, fittings and accessories, electrical clearances and salient guaranteed particulars, position of terminals and base mounting channels.
2. Internal arrangement of the CT.
3. Cross sectional view clearly indicating – core and windings with material specifications, various clearances, supporting/clamping arrangement of core, coil assembly and arrangement of primary and secondary side leads inside the CT.
4. Untanking details.
5. Porcelain bushing including cross sectional view, shed profile, creepage distance, clamping arrangement and other salient electrical mechanical characteristics.
6. Rigid and flexible terminal connectors.
7. Primary terminals and details of link and mounting arrangement.
8. Secondary terminals and secondary terminal box.
9. Rating and diagram plate, both in English and Hindi version.
10. Detailed part drawings of the following:
    a) Oil level gauge
    b) Nitrogen gas filling valve and oil filling port
    c) Oil drain pipe with plug.
    d) Pressure relief device.
    e) Cable gland
    f) Earthing terminals.
11. Any other drawing considered necessary by the successful firm/ manufacturer and /or purchaser.

13.2 A format of the title sheet to be adopted by the successful firm/ manufacturer for preparation of the drawings is at Annexure-VI.

13.3 The provisionally approved drawings shall be modified, if needed, as a result of changes necessitated during type test or as desired by the purchaser/Vendor approving authority. The modification shall be first got approved from the purchaser/Vendor approving authority and then incorporated in the drawing. If there are no modifications at all the provisionally approved drawings shall be finally approved.

13.4 After approval, six copies of each of the approved drawings along with two sets of reproducible prints for each drawing shall be supplied to each consignee (s). One set of reproducible prints shall also be supplied to Vendor approving authority.

13.5 The successful firm/ manufacture shall supply two copies of "operation/ maintenance manual" for each CT to each consignee (s). Two copies of the manual shall be supplied to Vendor approving authority.

14.0 TESTING OF CURRENT TRANSFORMER

14.1 General

14.1.1 Once a purchase order is placed for supply of a CT, the designs and drawings together with the Quality Assurance plan (QAP) shall be furnished to the purchaser/Vendor approving authority as the case may be within the period stipulated in the order. Only after all the designs and drawings as well as the QAP have been approved for prototype tests and a written advice given to that effect, the successful firm/ manufacturer shall take up the manufacturing of the prototype of the CT. It is to be clearly understood that any change or modification required by the above authorities to be done in the prototype shall be done expeditiously. Such change or modification shall be incorporated in the drawing as indicated in clause 13.3.

14.1.2 Prior to giving a call to the purchaser/Vendor approving authority, for inspection and testing of the prototype, the successful firm/ manufacturer shall submit a detailed test schedule consisting of schematic circuit diagrams for each of the tests and the number of days required to complete all the tests at one stretch. Once the schedule is approved, the tests shall invariably be done accordingly. However, during the process of type testing or even later, the purchaser/Vendor approving authority, reserves the right to conduct any additional test(s), besides those specified herein, on any equipment/ item so as to test the equipment/ item to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the successful firm/manufacturer and representative of the purchaser/Vendor approving authority, during the process of testing as regards the procedure for type tests and /or the inspection and acceptability of the results of type tests, it shall be brought to the notice of the purchaser/Vendor approving authority, as the case may be, whose decision shall be final and binding. Only after the prototype CT is completed and ready in each and every respect, the successful firm/ manufacturer give the actual call for the inspection and testing with at least 15 days' notice for the purpose.

14.1.3 In the event of the tests not being carried through to completion at one stretch for any reason attributable to the successful firm/ manufacturer and it is required for the representative of the purchaser/Vendor approving authority, to go again of more number of times to the works of the successful firm/ manufacturer or other place(s) for continuing and /or completing the tests on the prototype(s) of the equipment, the successful firm/manufacturer shall reimburse to the purchaser/ Vendor approving authority, shall be paid through a demand draft to the concerned accounts officer of the purchaser/Vendor approving authority, as shall be advised to the successful firm/ manufacturer.

14.2 Type tests.

The type tests shall be carried out on the prototype CT at the works of the successful firm/ manufacturer or at any reputed laboratory or testing house in the presence of the representative of the purchaser/Vendor approving authority, in accordance with IS: 2705 and as altered, amended or supplemented by this specification. The following shall constitute the type tests:

i) Temperature rise test.
ii) Lightning impulse test.
iii) Short time current test.
iv) High voltage power frequency wet withstand voltage test.
v) Determination of errors according to the requirement of the appropriate accuracy class.

Note - a. The limit of the temperature rise for oil immersed instrument transformer shall be reduced by 0.4% for each 100m that the operating site exceeds 1000m (Reference Para 6.4.2 of IEC:61869-1:2007)

b. For installation at altitude above 1000 meter and up to 2500 meter , the required power frequency withstand voltage & Lightening impulse withstand voltage shall be in accordance with Para 6.6.2 of IEC: 61869-1:2007

14.2.1 Temperature rise test

The temperature rise test shall be done for the parallel configuration of the windings. The test shall be done in accordance with clause 7.2 and 9.7 of IS: 2705 (Part I) and shall be carried out, fitted with the approved terminal connectors for rated current.

14.2.1.1 The points to be ensured during the temperature rise test shall be:

i) Only alcohol in glass thermometers shall be used for the measurement of the ambient temperature.

ii) The temperature of the winding shall be determined by the resistance method only.

14.2.1.2 The temperature rise shall not exceed the limits mentioned under table of Para 5.0

14.2.2 Lightning Impulse Test:

This test shall be done in accordance with clause 9.8 of IS: 2705 (Part I) on the primary winding at a test voltage as mentioned under table of Para 5.0.

14.2.3 Short time current tests.

The short time thermal and dynamic (peak) current withstand tests shall be done in accordance with clause 9.6 of IS: 2705 (Part-I) to verify time ability of current transformers and the fitted terminal connectors to withstand the rated short time current mentioned under table of Para 5.0. The current transformer shall be deemed to have passed the tests subject to satisfying the conditions laid down in clause 9.6.3 of IS: 2705 (Part- I).

14.2.4 High voltage power frequency withstand test on primary winding.

14.2.4.1 This test shall be done in accordance with clause 9.9 of IS: 2705 (Part-I), the test voltage applied shall be as mentioned under table of Para 5.0.

14.2.5 Determination of errors (Accuracy class)

14.2.5.1 The CT shall conform to accuracy class 5P15. Test shall be done for current error, phase displacement and composite error in accordance with clause 7.1.1 and 7.1.2 of IS: 2705 (Part 3), to prove compliance with the requirements as mentioned under table of Para 5.0 of this specification.

14.2.6 PS class CTs shall be subjected to additional type tests as per clause 6.1 to 6.3 of IS: 2705 Pt-IV

14.3 Routine tests.

The routine tests shall be performed on each CT including the prototype unit. The following shall constitute the routine tests:

i. Visual examination
ii. Insulation resistance test.
iii. Over voltage inter turn test.
iv. Determination of error according to the requirement of apparatus accuracy class.
v. Measurement of resistance of the windings.
vi. Verification of terminal markings and polarity.
vii. Power frequency (dry) withstand test on primary winding.
viii. Power frequency (dry) withstand test on secondary winding.
ix. Excitation current test (for PS core only).
x. Measurement of minimum knee point voltage (for PS core only)

14.3.1 Visual examination: A general examination shall be made to check that the CT conforms to the provisionally approved drawings, various items are accessible for maintenance, the quality of workmanship and finish are of acceptable standards and all parts, fittings and accessories are provided.

14.3.2 Insulation resistance test.

The insulation resistance between primary winding and earth and between primary winding and secondary winding shall be measured using 2.5 kV megger. The insulation resistance between secondary winding and earth shall be measured using 500 V megger.

14.3.3 Over voltage inter turn test.

Over voltage inter turn test shall be done in accordance with clause 9.5 of IS: 2705 (Part I).

14.3.4 Accuracy test

The accuracy test shall comprise of:

a) Current error and phase displacement at the rated primary current.
b) Composite error at the rated accuracy limits primary current.

The above tests shall be conducted in accordance with clause 7.2.1 and 7.2.2 of IS: 2705 (Part 3) to prove compliance with the requirements as mentioned under table of Para 5.0 of this specification.

14.3.5 Measurement of resistance of the windings.

The resistance of each of the winding shall be measured and computed at 75 deg. C.

i. The secondary winding resistance shall not exceed 0.3 ohm (for CTs to be used on 25 kV side).
ii. The secondary winding resistance shall not exceed the values declared by manufacturer in SOGP (for CTs to be used on HV side)

14.3.6 Verification of terminal markings and polarity.

The terminal markings and polarity shall be verified in accordance with approved drawing as per clause 9.2 of IS: 2705 (Part I).

14.3.7 Power frequency (dry) withstand test on primary winding.

The test shall be conducted as per clause 9.3 of IS: 2705 (part I). The test voltage applied shall be as given below:

i.	Nominal system voltage, in kV	220	132	110	66	50	25	11
ii.	Voltage to be applied Between primary winding and earth, kV(rms)	460	275	230	140	140	95	28
iii.	Voltage to be applied Between two sections of the primary winding, kV(rms)	2	2	2	2	2	2	2

14.3.8 Power frequency (dry) withstand test on secondary winding.

The test shall be conducted as per clause 9.4 of IS: 2705 (part 1). The test voltage applied shall be 3 kV (rms) for one minute.

14.3.9 Excitation current test:

The excitation curve shall be drawn at the least up to that point where an increase of 10 % in voltage results in an increase of 100 % in current. The exciting current at the knee point voltage shall not exceed 500 mA.

14.3.10 Measurement of minimum knee point voltage.

The minimum knee point voltage shall be measured in accordance with clause 6.1 of IS: 2705 (Part IV) (PS cores only).

14.3.11 PS class CTs shall be subjected to additional type tests as per clause 6.1 to 6.3 of IS: 2705 Pt.-IV.

14.4 Test on parts, fittings and Accessories.

14.4.1 Porcelain housing:-

The porcelain housing shall be tested in accordance with Governing IS/IEC and the certificates for compliance with the standard shall be furnished. The porcelain housing shall also meet the requirement of clause 7.3 of this specification.

14.4.2 Terminal connector:-

The terminal connector shall be tested in accordance with IS: 5561 and the certificate for compliance with the standard shall be furnished.

14.4.3 Pressure relief device:-

The pressure relief device (PRD) shall be subjected to air pressure test and leakage test. The PRD should be designed to operate at a pressure between 2.5 to 4.5 kg/cm^2.

14.4.4 Insulating oil

The sample of insulating oil drawing from the prototype unit shall be tested in accordance with IS: 335 or as per IEC 60296.

14.5 Failure of Prototype:

14.5.1 In the event of the prototype CT failing in any one of the tests, further testing shall be discontinued. The manufacturer after carrying out all the modification as required on the CT shall offer a fresh prototype for carrying out all the tests indicated above.

14.6 Waiver of Tests:

14.6.1 If the prototype of the CT to this specification has already been approved in connection with previous supplies to Indian Railways, fresh type testing may be waived at the discretion of the

purchaser, provided that no changes whatsoever in the design or material(s) used or the process of manufacture have been made. However, the purchaser reserves the right to conduct type tests if he deems it necessary to do so in the light of experience gained from previous supplies.

14.7 Bulk manufacture:

14.7.1 Only after approval of the original tracings of drawings incorporating changes, if any, as result of the prototype tests and clear written approval of the results of the tests on the prototype is communicated by the purchaser/Vendor approving authority to the successful firm/ manufacturer, shall be taken up bulk manufacture of the CT, which shall be strictly with the same materials and process of manufacturer as adopted for the prototype. In no circumstances shall materials other than those approved in the design/ drawings and/or during the prototype testing be used for bulk manufacture on the plea that they had been obtained prior to the approval of the prototype.

15.0 TECHNICAL DATA AND DRAWINGS:

15.1 The firm shall furnish along with his offer, in the proforma at Annexure- VII, the schedule of guaranteed performance, technical and other particulars (SOGP) for the CT. The particulars shall be correct and complete in all respects. If there is any entry like “shall be furnished later” or a blank against any item, the application is not likely to be considered.

15.2 The firm shall specifically indicate in a statement of compliance “attached with the offer his compliance with each and every clause of this specification. In case the firm wishes to deviate from any clause of this specification he may do so giving reference to the clause(s) with the reasons/ justification for the deviation. This shall be in the form of a separate statement called the statement of Deviations”. If there is no deviation at all, a specific NIL Statement of compliance “ and “ Statement of Deviation” are not attached with the offer, it is not likely to be considered for the reasons that it is an incomplete offer which cannot be properly evaluated and compared with other offers, if any.

15.3 The firm shall furnish the following drawings as per Railways standard in sizes 210mm x 297 mm, or any integral multiples thereof along with his offer:-

i) Outline general arrangement drawing giving the overall dimensions of the transformer.

ii) Rating and diagram plate.

iii) Internal arrangement of the CT including cross- sectional views.

16.0 TRANSPORTATION OF CURRENT TRANSFORMER

16.1 The CT may be transported by the transport facilities available for the route, viz, rail, road or sea. All parts, fittings and accessories which are liable to damage during transit shall be removed and packed/ crated separately. Detached parts may be packed/ crated and sent with CT along with the packing list, so that all the parts are available at the destination with the unit. The packing has to be done properly so that no damage occurs during transit.

16.2 The various components of each CT shall be securely packed in suitable bio-friendly material/wooden crates and boxes. General packing list, together with weight and overall dimensions of packing cases shall be furnished for each CT indicating the following:

Crate No.	Description of item/component in the crate	Approx. gross Weight in kg.	Approx. outside Dimensions

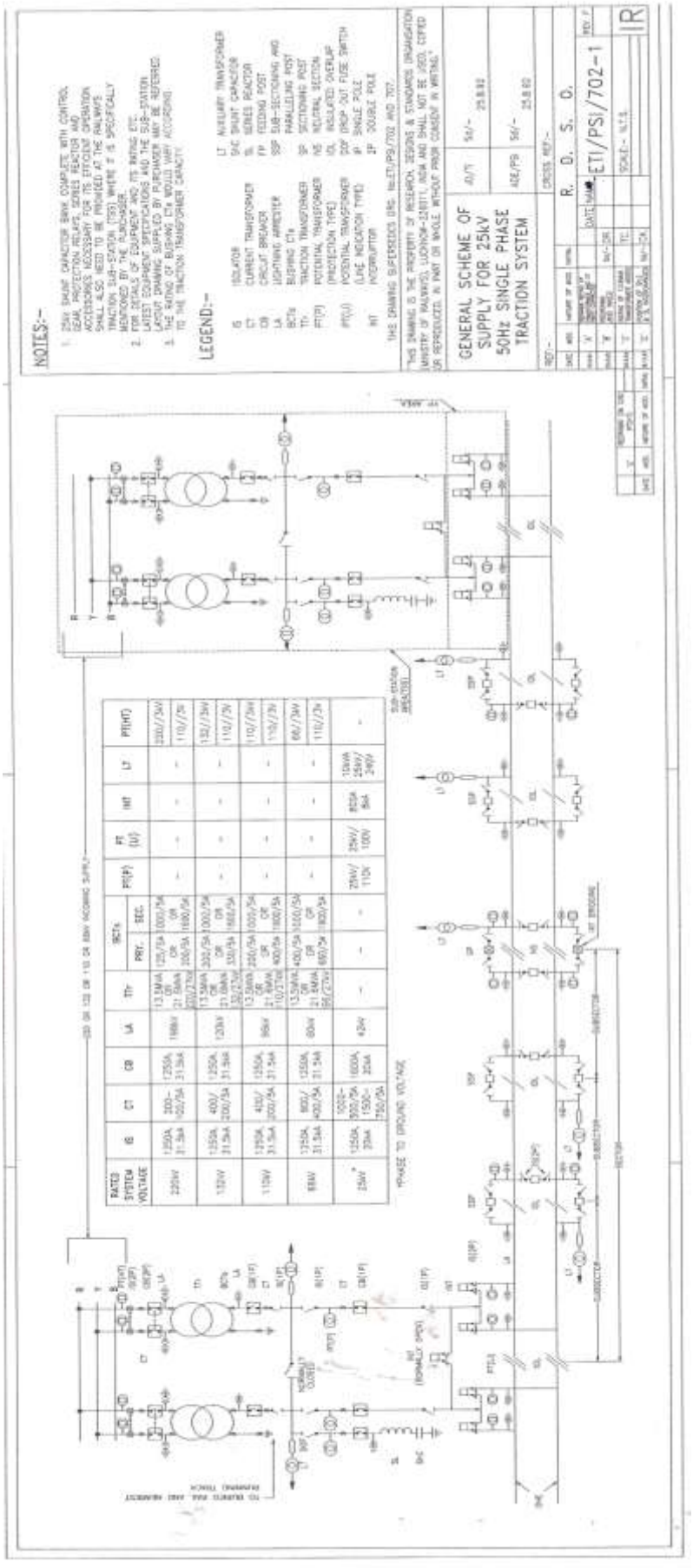
16.3 As far as possible, the gross weight of the crate/ box shall be so kept that it can be conveniently handled by two persons.

16.4 In case of overseas supplies, packing shall be sea worthy.

16.5 Necessary instructions for handling and storage of all items shall be included along with the packing lists.

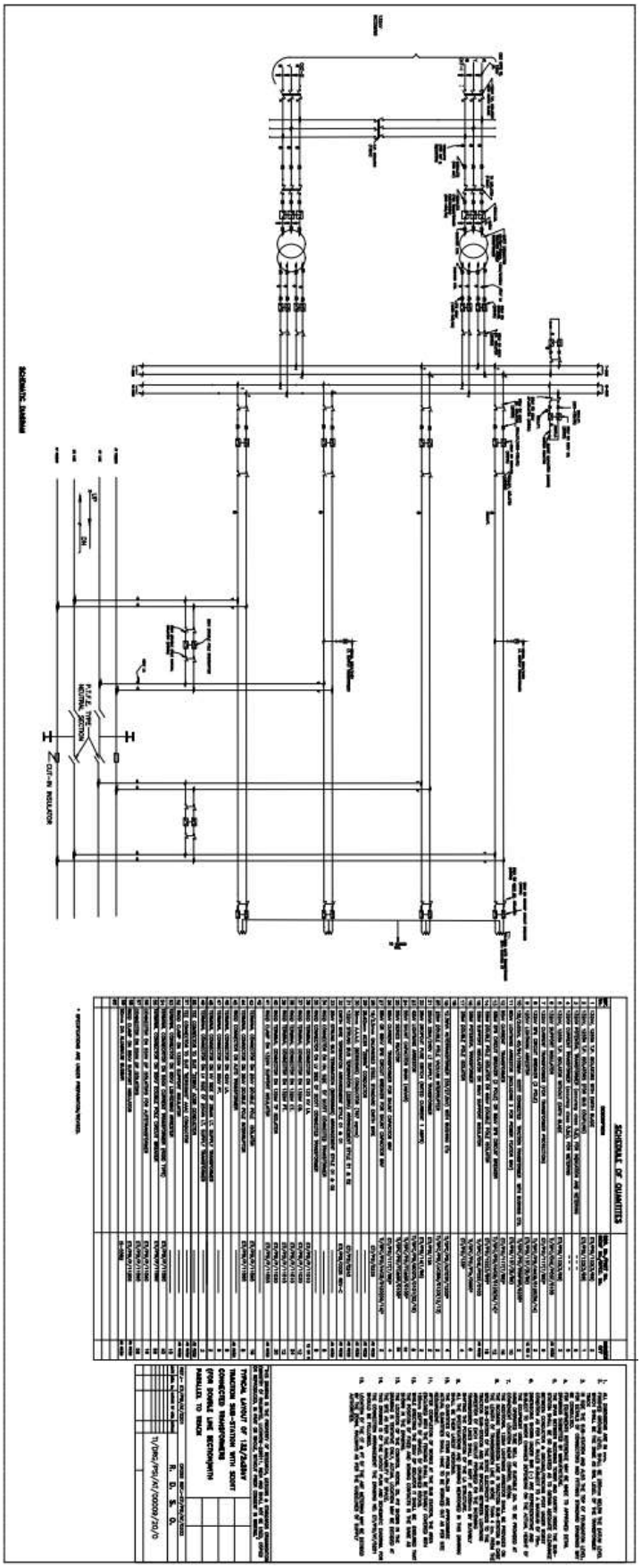
****

ANNEXURE - I


NOTES:-
LEGEND:-
GENERAL SCHEME OF SUPPLY FOR 25kV 50Hz SINGLE PHASE TRACTION SYSTEM
R. D. S. O.
ETI/PSI/702-1
IR

ANNEXURE-1-A

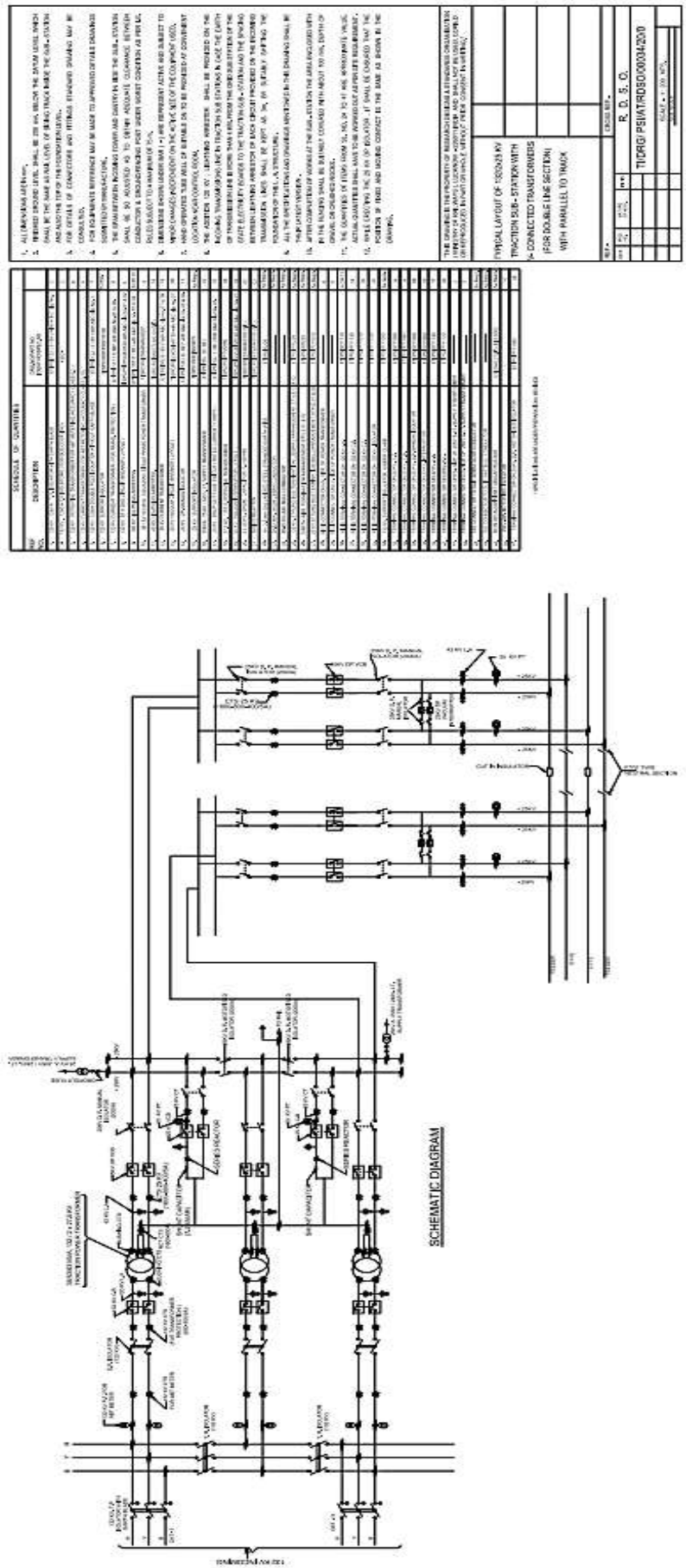
GENERAL SCHEME OF POWER SUPPLY FOR 2 x25 kV AC NEW SYSTEM



132kV Double Line Scott parallel to track

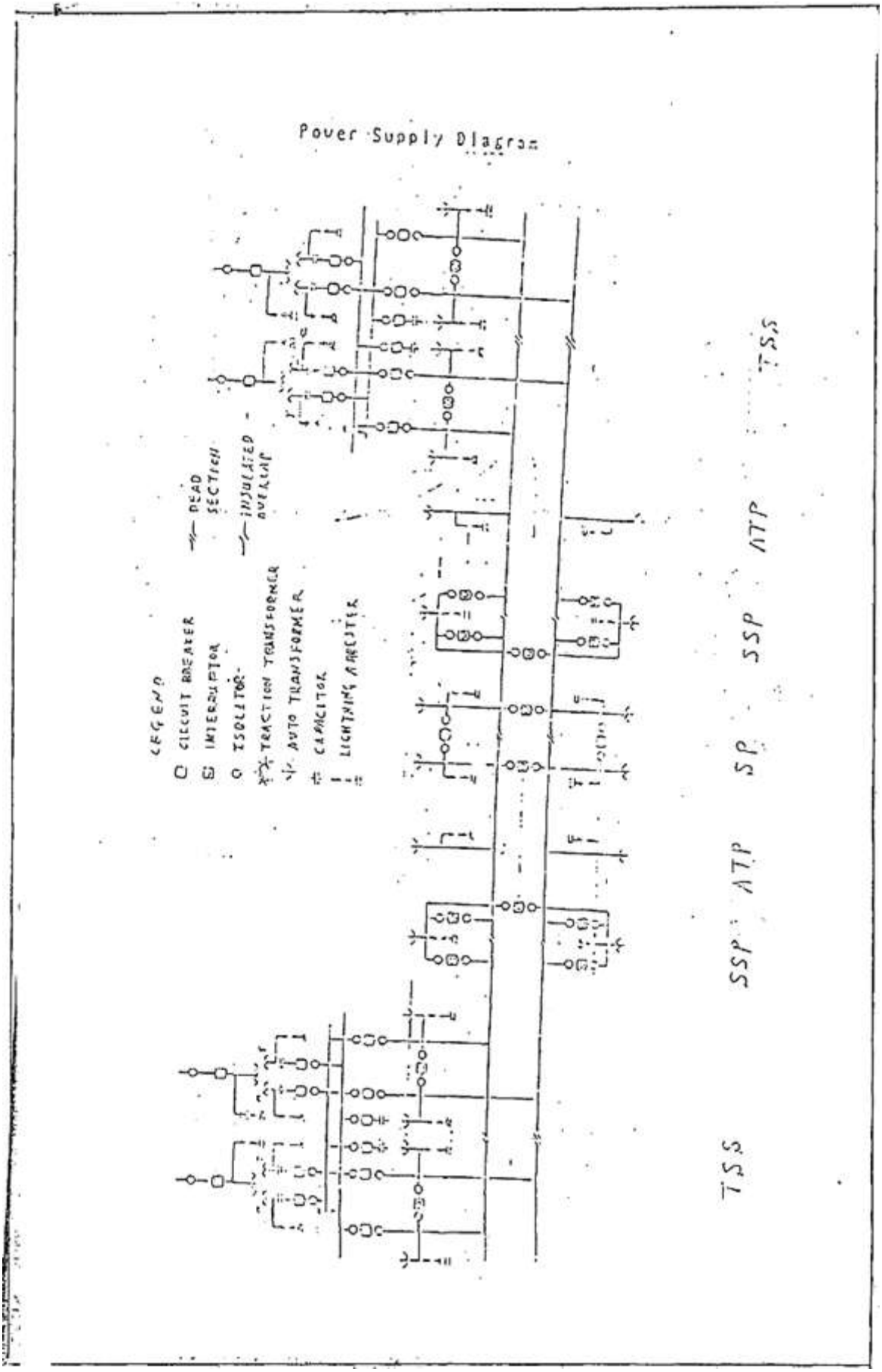
ANNEXURE-1-B

GENERAL SCHEME OF POWER SUPPLY FOR 2 x25 kV AC NEW SYSTEM

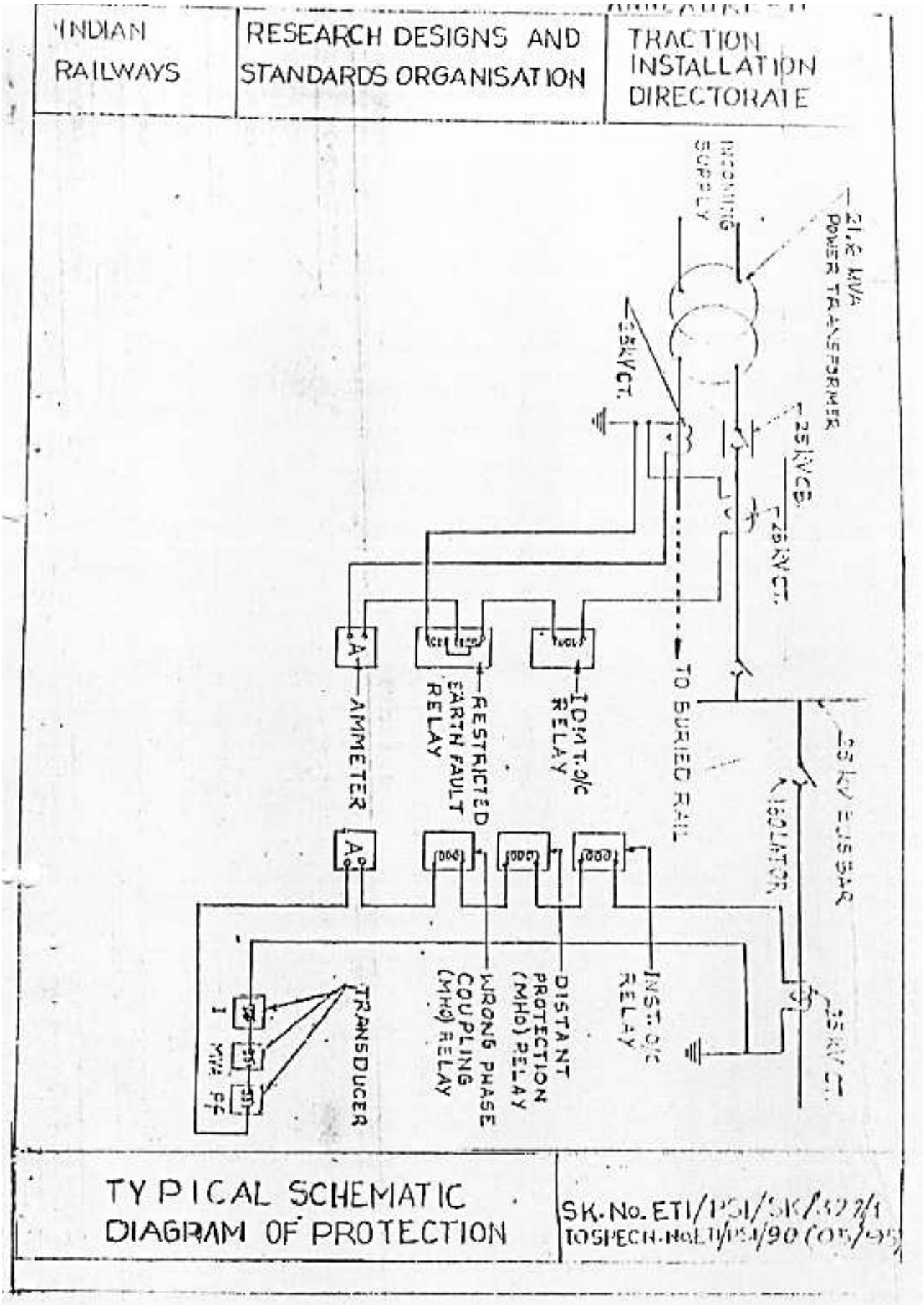


132kV Double Line V Connected parallel to track

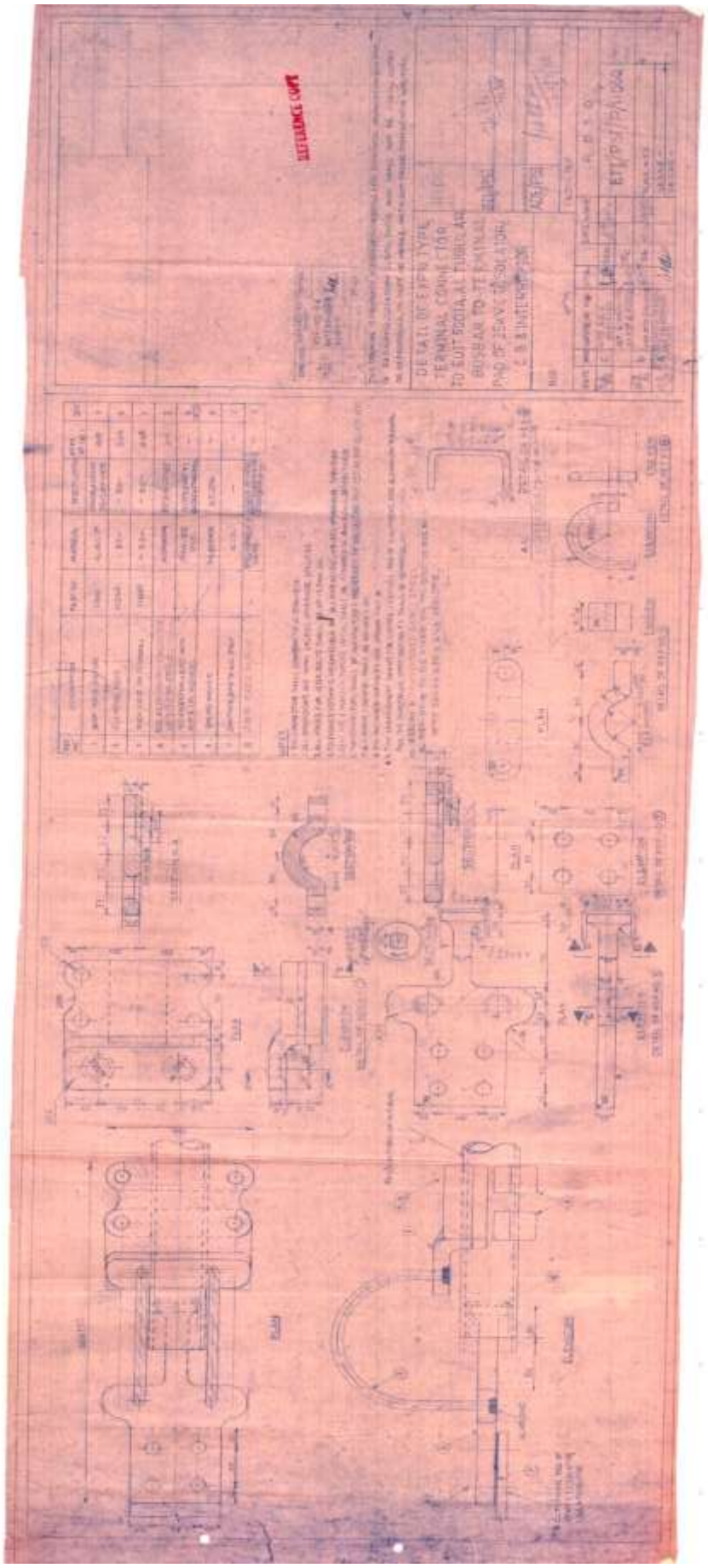
ANNEXURE-1-C


Power Supply Diagram
LEGEND
CIRCUIT BREAKER
INTERRUPTOR
ISOLATOR
TRACTION TRANSFORMER
AUTO TRANSFORMER
CAPACITOR
LIGHTNING ARRESTER
DEAD SECTION
INSULATED OVERLAP
TSS
SSP
ATP
SP
SSP
ATP
TSS

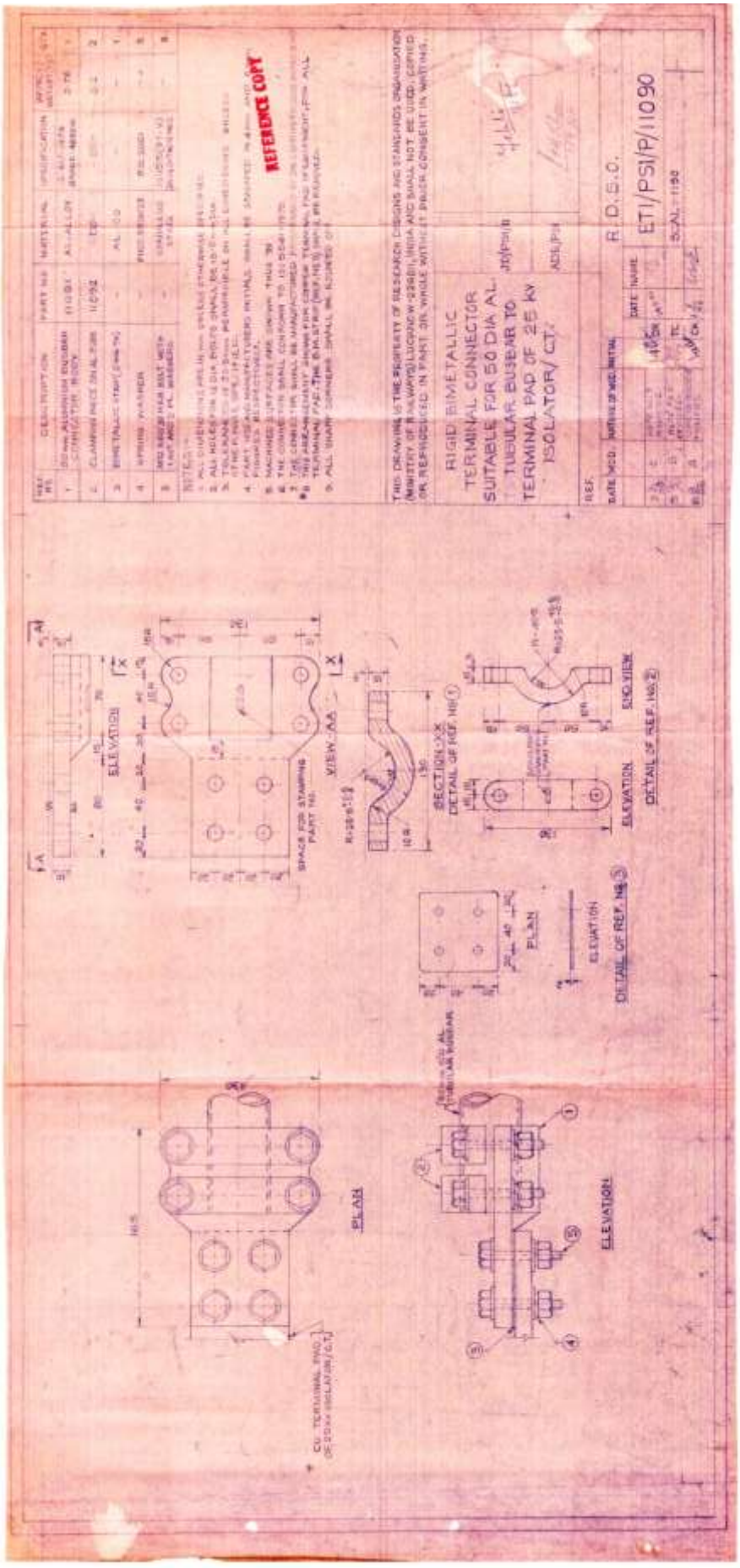
ANNEXURE-II


INDIAN RAILWAYS
RESEARCH DESIGNS AND STANDARDS ORGANISATION
TRACTION INSTALLATION DIRECTORATE
INCOMING SUPPLY
21.6 MVA POWER TRANSFORMER
25KV C.T.
25KV C.B.
25KV C.T.
TO BURIED RAIL
25 KV BUS BAR
ISOLATOR
A
AMMETER
RESTRICTED EARTH FAULT RELAY
I.D.M.T. O/C RELAY
INST. O/C RELAY
DISTANT PROTECTION (MHO) RELAY
WRONG PHASE COUPLING (MHO) RELAY
TRANSDUCER
TYPICAL SCHEMATIC DIAGRAM OF PROTECTION
SK. No. ETI/PSI/SK/
TOSPECH. No. ETI/PSI/90

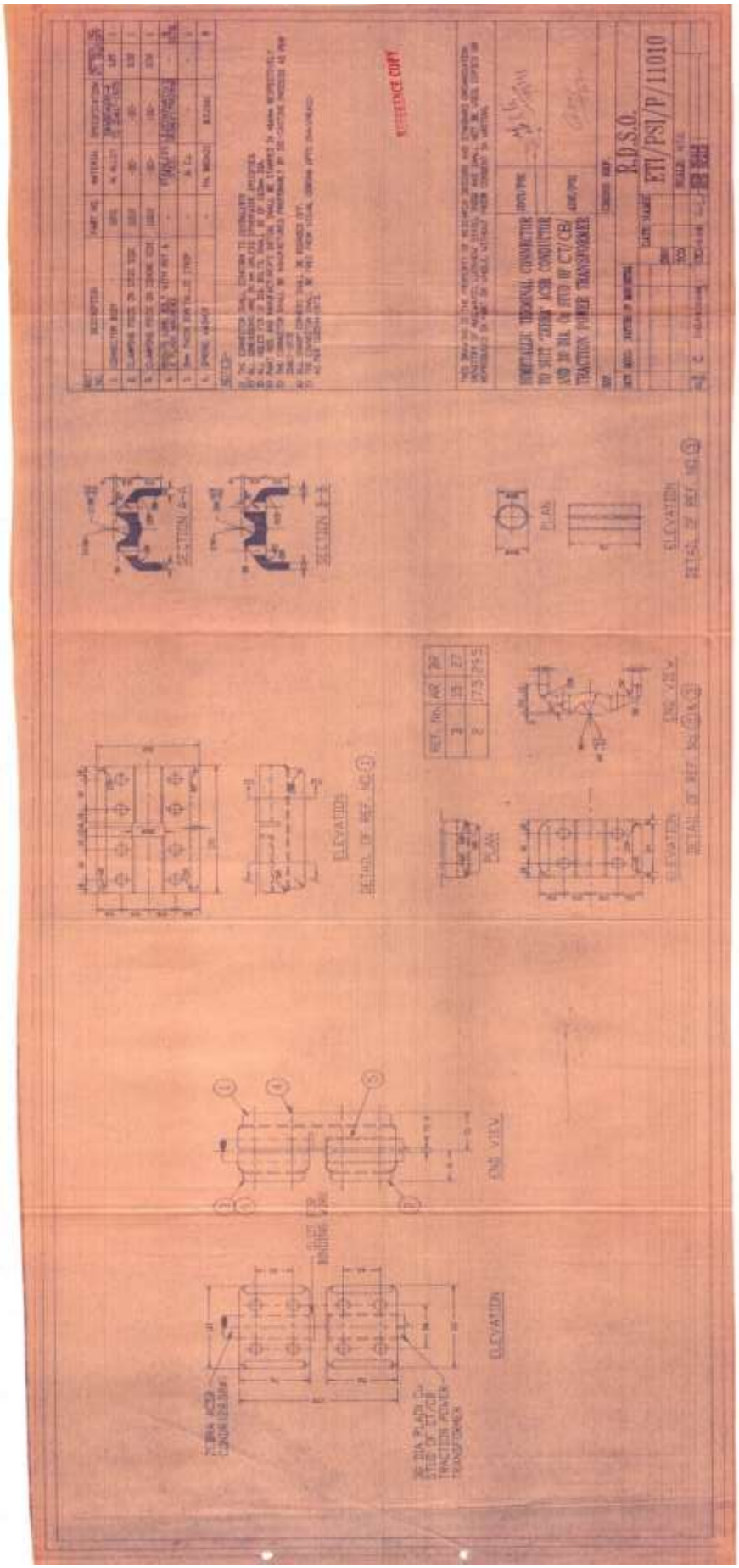
ANNEXURE-III



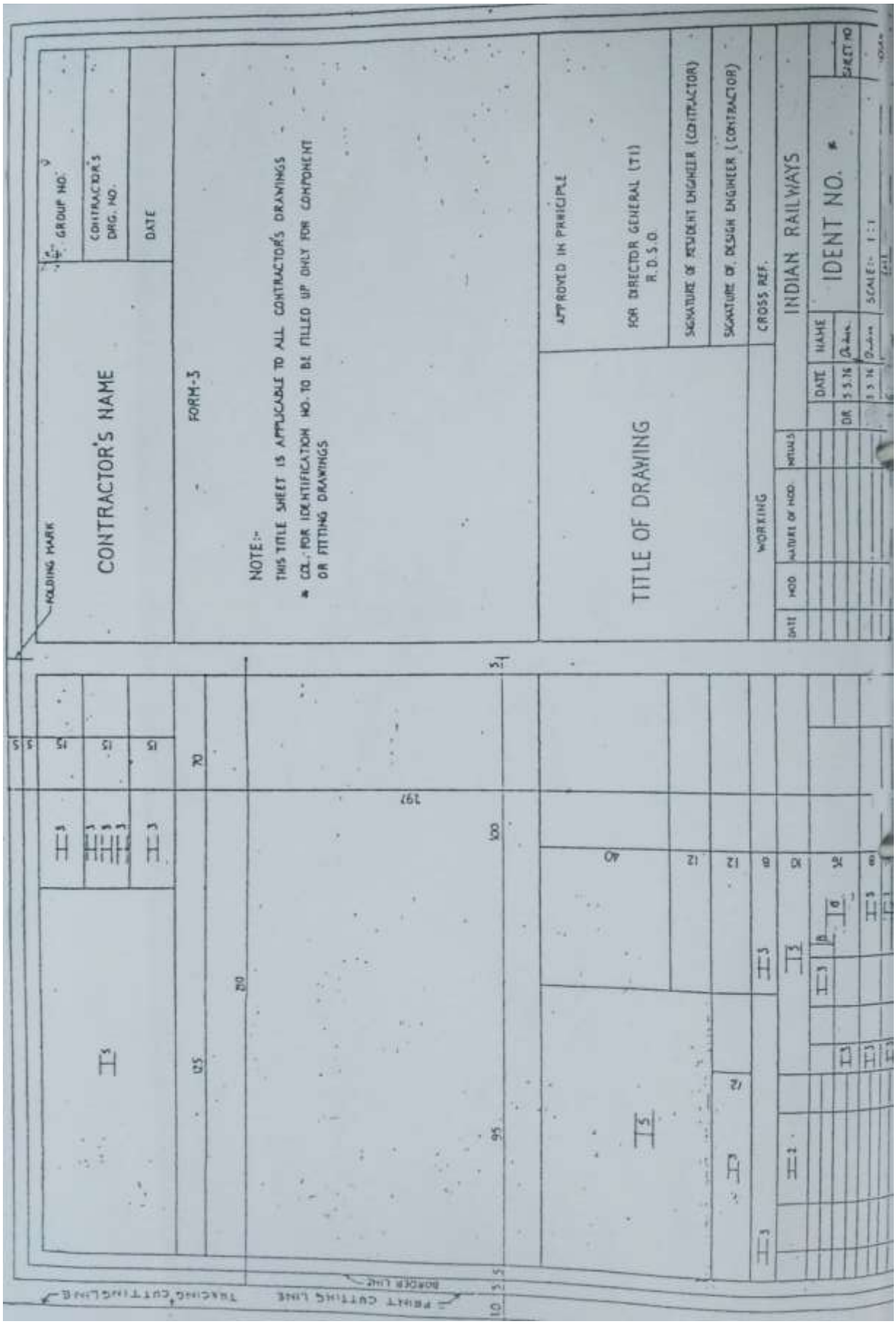
ANNEXURE-IV


REFERENCE COPY
RIGID BIMETALLIC TERMINAL CONNECTOR SUITABLE FOR 50 DIA AL. TUBULAR BUSBAR TO TERMINAL PAD OF 25 KV ISOLATOR/ CT
R.D.S.O.
ETI/PSI/P/11090
ELEVATION
VIEW AA
SECTION XX
DETAIL OF REF. NO (1)
SIDE VIEW
ELEVATION
DETAIL OF REF. NO (2)
PLAN
ELEVATION
DETAIL OF REF. NO (3)
PLAN
ELEVATION

ANNEXURE-V



ANNEXURE-VI


FOLDING MARK
CONTRACTOR'S NAME
GROUP NO.
CONTRACTOR'S DRG. NO.
DATE
FORM-3
NOTE:-
THIS TITLE SHEET IS APPLICABLE TO ALL CONTRACTOR'S DRAWINGS
* COL.: FOR IDENTIFICATION NO. TO BE FILLED UP ONLY FOR COMPONENT OR FITTING DRAWINGS
APPROVED IN PRINCIPLE
FOR DIRECTOR GENERAL (TI) R.D.S.O.
SIGNATURE OF RESIDENT ENGINEER (CONTRACTOR)
SIGNATURE OF DESIGN ENGINEER (CONTRACTOR)
CROSS REF.
WORKING
TITLE OF DRAWING
INDIAN RAILWAYS
IDENT NO. *
SHEET NO
SCALE:- 1:1
DATE
NAME
DR.
DATE
NATURE OF MOD.
MOD
MTLS
PRINT CUTTING LINE
TRACING CUTTING LINE
BORDER LINE

ANNEXURE-VII

SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS OF CURRENT TRANSFORMER.

Note: Guaranteed particulars are to be established by actual test/ test reports.

S.No.	Description	Unit of measurement
1	Name of the manufacturer	
2	Country of manufacture	
3	Reference to specification based on which performance data is based.	
4	Manufacturer's type designation	
5	Rated system voltage	
6	Highest voltage for equipment	
7	Rated primary current	
8	Rated secondary current	
9	Rated frequency	
10	Rated burden	
11	Rated transformation ratio	
12	Accuracy class	
13	Rated accuracy limit factor.	
14	Current error at rated primary current	
15	Phase displacement at rated primary current	
16	Composite error at rated accuracy limits primary current.	
17	Rated short time thermal current for 1 s.	
18	Temperature Rise Over a maximum ambient air temperature of 50°C after continuous full load operation i) Of oil by thermometer ii) Of winding by resistance.	
19	Core particulars: i) Type ii) Maximum flux density at a) Rated primary current b) 15 times rated primary current iii) Thickness of steel stamping iv) Grade of core material and conforming specification v) Watt loss/kg vi) Minimum knee point (emf) voltage (for PS core only). vii) Exciting current at knee point (emf) voltage (for PS core only).	
20	Winding particulars: i) Type of primary winding ii) Current density in primary winding at rated current iii) 1) Size and number of turns of primary winding 2) Size and number of turns of secondary winding. 3) Resistance of primary winding at 75 deg. C 4) Resistance of secondary winding at 75 deg. C. iv) Conforming to IS specification No. v) Class of insulation (a) Primary winding (b) Secondary winding vi) Type of joint in the winding if any. vii) Rated lightning impulse withstands voltage. viii) Power frequency withstands voltage of primary terminal.	

21	Porcelain housing: i) Name of the manufacturer ii) Manufacturer's type designation. iii) Standard specification on which the performance data are based. iv) Voltage class v) Rated current vi) Minimum creepage distance vii) Weight	
22	Weight and dimensions: i) Net weight of core ii) Net weight of copper in a) Primary winding b) Secondary winding iii) Net weight of steel enclosure, fittings iv) Total weight of CT v) Volume of oil vi) Weight of oil vii) Overall dimensions of the CT a) Height Length b) Breadth	
23	Name of suppliers and conforming IS specification No. i) Terminal connector. ii) Fasteners a) Stainless steel b) MS hot dip galvanised. iii) Winding wire iv) Gaskets. v) O' rings. vi) Core material.	
	Other Particulars.	
24	Is the CT fitted with lifting lugs?	
25	Is the porcelain housing of bushing of single piece construction?	
26	Whether the CT is of sealed construction with Nitrogen at top.	
27	Is the shed profile of porcelain housing free from under rigs but has a lip	
28	Pressure relief device provided or not	
29	Is clause by clause statement of compliance attached	
30	Is statement of deviation if any, attached	
31	Are fasteners of 12 mm dia and less exposed to atmosphere of stainless steel to grade 04 Cr 17 Ni 12 Mo2 to IS: 1570 (part II).	
32	Are the fasteners of more than 12 mm dia exposed to atmosphere?	Stainless steel or MS hot dip galvanised
33	i) Are all the parts, fittings and accessories from RDSO's approved manufacturer's.? ii) If not, list the items which are to be type tested in the presence of Vendor approving authority representative.	
34	Are all the drawings required as per clause 15.3 (I, II & III) attached.	
35	Is warranty as per clause 16.0?	
36	Is the list of spares furnished?	

Annexure-VIII

1.0 SCOPE

This part of specification cover design, manufacture, testing , inspection, packing and supply of 145 kV class outdoor, current transformers with CT ratio of 1200-800-400/5A to the specification given below to be used in Mumbai area on 110 kV side at traction sub-station with 30 MVA transformers and required to be operated is parallel with adjacent traction sub-stations.

2.0 RATING AND OTHER PARTICULARS

i)	Type	Single phase, oil filled natural air cooled outdoor		
ii)	No. of cores	4		
iii)	System voltage a) Nominal system voltage, kV b) Highest system voltage, kV	 132 145		
iv)	Rated primary/ secondary currents a) Primary current, Amp b) Secondary current, Amp	 1200 5		
v)	CT ratio	1200-800-400/5A		
Vi)	Rated frequency	50 Hz +/- 3%		
vii)	Class of insulation	A		
Viii)	a) Short time current rating (thermal) for 3 second, kA b) Short circuit withstand current (3 sec.), kA c) Short time current rating (Dynamic), kA (peak)	40 40 100		
ix)	Rated insulation level a) One minute 50 Hz withstand voltage/ induced over-voltage, kV (rms) b) Impulse withstand voltage, positive and negative polarity (1.2/50 microsecond wave), kV (peak)	 275 650		
x)	Minimum creepage distance of insulator (31 mm/kV),mm	4495		
xi)	Temperature rise Maximum temperature rise of windings immersed in oil	 50^0C over an ambient of 50^0C		
xii)	Rated over load	150% of full load for 15 minutes		
xiii)	Rated burden & class of accuracy of different cores	Core-1	Core-3	Core-2&4
		Protection	R met	Protection
	Burden in VA	40	40	-
	Accuracy Class	5P20	0.2	PS
	Instrument Security Factor	-	<5	-
	Knee point Voltage	-	-	>750V
	Iex (max) at Vk/2	-	-	<100 mA
	Rct(max)			< 1.0 Ohm at max. Tap.

2.1

a) Multi-ratio specified shall be obtained by taps on secondary side.
b) The values specified above for metering & protection core shall be met for the lowest tap. (Except) Rct and knee point voltage for PS core which is at the highest tap).
c) P1 and P2 markings to be permanently riveted.
d) CTs shall be of dead tank design.
e) Power factor terminal (test tap) shall be provided inside the secondary terminal box.
f) The disposition of various CT cores and detailed drawings along with SOGP shall be furnished for Vendor approving authority's approval before manufacture is taken up.

3.0 Construction

The current transformers shall be hermetically sealed. They shall be suitable for upright mounting on steel structures. They shall be provided with nitrogen cushions/ stainless steel bellows. CTs shall be suitable for hot line washing. The current transformer winding shall be housed in a galvanised tank suitable for outdoor duty. Earthing arrangement shall be provided for CT tank.

3.1 Construction

Tank shall be fabricated from tested quality low carbon steel suitable for welding and of adequate thickness. The tank shall be designed to withstand mechanical shocks during transportation, vacuum filling of oil and continuous internal pressure over normal hydrostatic pressure of oil and short circuit forces.

The construction of tank shall be designed to prevent ingress of water into or leakage of oil from the tank. All bolted connections shall be fitted with weather proof, hot oil resistant gasket in between (futile Nitrile/ Neoprene Rubber) for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.

Tank fabrication drawings shall be submitted for approval before the manufacturing is taken up.

3.2 SPECIAL CONSTRUCTION NOTE

After the internal elements such as primary & secondary windings are sealed in the tank with porcelain shell, the assembled CTs shall be subjected to vacuum & heat treatment and finally filled with degasified oil in vacuum.

4.0 General

4.1 Current transformers shall be provided with unthreaded and stud terminals at top for connections to 110 kV, 50 mm OD aluminium bus bar. The primary current terminals shall be of tinned copper.

4.2 The current transfer area of the terminals shall be adequate to meet the temperature rise requirements as per IEC 44-1/IS: 2705 for CTs. The cross – section area of the terminal shall be indicated in the drawings.

4.3 Mechanical load test on primary terminals: Test reports are to be submitted as per IEC 44-1.

4.4 The burdens specified for different cores refer exclusively to connected burden and should exclude the bleeder resistances if any. Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

4.5 CTs shall be provided with a capacitance test tap in the HV lead to enable future monitoring of conditions of HV insulation.

4.6 Earthing terminal shall be provided in the secondary junction box for earthing of secondary winding of CT.

4.7 The alignment and centre line of CT primary terminals shall be correct so as to avoid bending of connections.

4.8 The CT secondary terminal box shall be of GI (IP55) and shall be provided with collar to prevent entry of moisture & good neoprene gaskets designed to prevent entry of foreign particles. Junction box shall be sufficiently large to connect 1100 V upgrade, 40x6 Sq.mm cables through cable glands for all the secondary cores.

4.9 CT secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. CT secondary terminals shall be provided with lock nuts.

4.10 All ferrous parts exposed to atmosphere including main tank, secondary terminal box & top metallic should be hot dip galvanized.

4.11 The current transformers shall be supplied complete with insulating oil conforming to IS: 335 and railway requirements. The insulating oil shall be procured from the manufacturers approved by RDSO. The successful firm/ manufacturer shall submit test certificates as per IS: 335 for oil.

4.12 The firm shall furnish their compliance or otherwise against each clause/ sub-clause of the technical specification. If the firm wishes to deviate from the provision of any clause/ sub-clause, he shall furnish the full details with justification for such deviation.

4.13 Details drawings of CT along with SOGP shall be furnished to Vendor approving authority's approval before manufacture is taken up.

4.14 This CT shall be used for following additional protective devices/ relays.

i) Fibre optic line differential protection
ii) Directional over current relay
iii) LBBU relay (LBB- breaker failure relay)
iv) Bus bar differential low impedance type protections relay
v) Energy metering.

5.0 The following type & routine tests as per IEC 44-I, IS: 2705 and RDSO specification No. TI/SPC/PSI/CT/0210 shall be conducted on the current transformer required for Mumbai area under DC-AC conversion.

5.1 Type Tests.

1. Visual inspection
2. Temperature rise test.
3. Impulse voltage test.
4. Short time current test.
5. Excitation test and plotting of magnetizing characteristic curves.
6. Radio interference test.
7. Seismic withstand test.
8. The CTs shall be subjected to fast transient test in order to evaluate the ageing characteristics of the CT insulation. This test is to be done to assess the CT performance in service to withstand the high frequency over voltage generated due to closing and opening operations of isolators.

5.2 Routine tests.

1. Dimensional check
2. Verification of terminal marking and polarity.
3. Power frequency voltage withstand tests on primary winding.
4. Power frequency voltage withstand tests on secondary winding.
5. Accuracy tests.
   a) Current error and phase displacement at the rated primary current
   b) Composite error at rated accuracy limit primary current
6. Measurement of knee point voltage, exciting current and ISF test (only for metering core).
7. Measurement of winding resistance test
8. Insulating resistance measurement test
9. Inter turn over voltage test.
10. Partial discharge test (PD value shall be less than 5 pC) - As per Cl. No. 5.3.3.1 of IS 16227Pt-1
11. Capacitance and tan delta value measurement (tan delta value shall be less than 0.005) - As per Cl. No. 7.4.3 of IS 16227Pt-1
12. Oil leakage test