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सत्यमेव जयते

भारत सरकार – रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ – 226011
Government of India - Ministry of Railways
Research, Designs & Standards Organization, LUCKNOW - 226011

No. EL/4.3.35/AC-DC

Dated: 06.11.2012

Chief Electrical Engineer,
मुख्य विद्युत इंजीनियर,

- Western Railway, Churchgate, Mumbai-400 020
- पश्चिम रेलवे, चर्चगेट, मुम्बई – 400020.
- Central Railway, Mumbai CST-400 001
- मध्य रेलवे, मुम्बई सी.एस.टी – 400001.

Sub: Technical Circular no. RDSO/2012/EL/TC/0120, Rev'0' dt. 06.11.2012 for repair of LOT 1250 KVA transformers fitted on 3-ph propulsion EMUs in Mumbai Sub-urban Railways.

Ref: Western Railway's letter no. 90/2/46 (OEE) dated 08.10.2012

In reference to above, RDSO has prepared a Technical Circular no. RDSO/2012/EL/TC/0120, Rev'0' dt. 06.11.2012 for repair of LOT 1250 KVA transformers fitted on 3-ph propulsion EMUs in Mumbai Sub-urban Railways. This Circular among others gives the technical specification, brief scope of work and sources for repair of this transformers for guidance of the Railways.

6/11/2012

(Sanjiv Swarup)
for Director General/Elect.

Encl: As above.

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Research, Designs & Standards Organization, LUCKNOW - 226011

No. EL/4.3.35/AC-DC

Dated: 06.11.2012

Chief Electrical Engineer,

- Western Railway, Churchgate, Mumbai – 400 020
- Central Railway, Parcel office, CST, Mumbai CST - 400 001

TECHNICAL CIRCULAR No. RDSO/2012/EL/TC/ 0120, Rev '0' dt. 06.11.2012

Repair of LOT 1250 KVA transformers fitted on 3-ph propulsion EMUs in Mumbai Sub-urban Railways

1.0 Background

1.1 LOT 1250 KVA transformers provided by M/s Siemens in the AC-DC EMUs against Contract No. GP-194 and MRVC Ph-I Project were manufactured by M/s ABB India/ABB Secheron, Switzerland, Original Equipment Manufacturers (OEM) of these transformers. Approximately 500 nos. of ABB make transformers have been provided in AC-DC EMUs running on CR & WR against the above contract.

1.2 Further, approximately 54 transformers of 1250 KVA for GP-194 Contract against option clause were also supplied by M/s Siemens and for these transformers, M/s Siemens is the OEM.

1.3 Western Railway vide their letter No. EL/90/2/46(OEE) dt. 08.10.2012 has requested RDSO to issue specification and test protocol for undertaking repairs of these transformers along with the approved sources.

2.0 Technical specification

Following parameters may be considered as technical specification for these transformers:

2.1 Catenary Voltage:

-	Nominal	-	25 KV
-	Maximum	-	30 KV
-	Minimum	-	16.5 KV

2.2 Frequency(Hz) - 50 Hz ± 6%

2.3 Thermal Rating of LOT 1250 KVA Transformer

Winding	Power[KVA]	Voltage[V]	Current[A]
Primary(1U-1V)	1250	22500	55.6
Traction 1(2U1-2V1)	625	855	731
Traction 2(2U2-2V2)	625	855	731

2.4 Percentage Impedance:

HV to Traction winding 1 or 2 : 39.4 % ± Tolerance as per IEC: 60310

2.5 Class of Insulation

(i) on conductors : Enamel of class H and nomex insulation of class H

(ii)Cooling medium : Class A(Mineral inhibited insulation oil as per IEC:60296)

2.6 Transformer losses at 22.5 KV

i) No load loss - : 1 KW + IEC Tol.
ii) Load losses for HV/TR1+2 at 85 °C 192 KW : 49 KW + IEC Tol.
iii) Total transformer losses : 50 KW + IEC Tol.

2.7 Transformer overall efficiency

At 25 KV : ≥ 96 %(approx.)

2.8 Permissible and designed temperature rise

(i) Oil (°C) : 45 °C [IEC 60310-20 °C]

(ii)Winding (°C) : 55 °C [IEC 60310-20 °C]

2.9 Type of Cooling and cooling medium

OFAF. Inhibited mineral Transformer Oil as per IEC: 60296

2.10 Dielectric levels

	Primary	Traction 1	Traction 2
(i) Induced voltage withstand (KV)	60	-	-
(ii) Separate source withstand (KV)	10	5	5
(iii) Impulse voltage withstand (KVp)	150	-	-

2.11 Bushing Details :

(i) HV bushing(1U) : 750 S1, Elastimold brand
(ii) HV return bushing (1V) : DIN 3DT250, Comem(EU), (India)
(iii) Traction bushing(2U1, 2V1, 2U2, 2V2) : DIN 3DT1000, Comem(EU),(India)

2.12 Quantity of Oil : 590 Liters

2.13 Total weight

Total weight of the transformer including oil and cooling equipments shall be – 3100 ±3% Kg

3.0 Technical details of Core & Windings:

Description of item	Details	
Grade of magnetic Core	M 4	
Type of core construction	Two limb core	
Net weight of core	500 Kg	
Weight of core & Coil assembly	1270 Kg	
Winding Description	HV winding	Traction Winding
Number of windings	1 HV winding	2 Traction winding (TR 1 & TR2)
Distribution of winding	HV winding is equally distributed on Limb 1 & 2 over the TR1 /TR2 winding.	TR1 on limb-1, TR2 on limb-2. These windings are over the core.
Winding Pattern	Layers	Layers
Type of Conductor	Round	CTC
Conductor Insulation	Enamel + Nomex, class H	Enamel + Nomex, class H
Number of parallel conductors	1 per HV coil associate to a TR winding, 2 coils in parallel	2 on each TR winding
Conductor size	2.36 mm	9 x 1.30 x 5.65
Size of insulated conductor	2.79 ± 0.02 mm	7.35-7.65 x 11.76- 11.91
Total cross section	8.74 mm2	128.35 mm2
Current density	6.4 A/mm2	5.69 A/mm2
Number of layers	18	6
Number of cooling channels	8	5
DC winding resistance at 85 °C	9.135 ohm	15.4 ohm
Number of turns	2682	102
Core to low voltage insulation	An epoxy cylinder surrounds the core. Over this cylinder, an oil duct is made and LV winding is directly wound on the axial spacers. Inside the LV winding, there is a provision of one cooling channel after each layer for ensuring the desired dielectric strength. The HV winding is wound around the TR winding after an oil channel starting with the layer is grounded. The HV winding is made of 18 layers. Two layers are insulated with two layers transformer board containing epoxy diamond dots that polymerize and rigidifying the HV coil. After each two layers an oil cooling duct is made.	

4.0 Bill Of Material (to be followed):

During repair of these transformers, OEM's Bill of Material (**Annexure-I**) shall be followed. Further, in addition to this sources, for transformer oil (as per IEC: 60296), HV bushing(750 S1) and various gaskets (Technical Circular No. ELRS/TC/0076) could also be considered.

5.0 Repairing Agencies

All the approved sources of conventional/3-ph loco transformers listed in the current vendor list of RDSO & CLW including OEM(M/s ABB) may be considered as repairing agencies for these transformers. In this connection, RDSO's letter No. EL/3.6.1/3 dt. 24.08.2011 or latest may be referred.

6.0 Testing Required on the repaired units

Testing of the repaired unit shall be conducted as per the test schedule mentioned in the **Annexure-II**. Further, in addition to this, the provision of conducting Impulse & Temperature rise test on the first repaired unit by the repairing agencies on their first repair order shall be made in the Works Contract.

7.0 General Scope of Works

The Scope Of Work for repair/rehabilitation of the transformer unit shall comprise the following essential description in addition to the general scope of work for repair/rehabilitation of transformer being followed in the Railways for repair of other transformers for rolling stock application as per the current practices in vogue:-

i) Rewinding/replacement of coils. This also includes the replacement of all the Pre Compressed Board (PCB), Permawood, paper insulation and other solid insulations used in the transformer.

ii) Replacement of core partly or fully depending upon the extent of failure.

iii) Replacement of complete oil conforming to IEC:60296.

iv) Replacement of cover gaskets/, bushing gaskets, valve gaskets and other gaskets, if any.

v) Replacement of HV/traction bushing, if found damaged.

vi) Replacement of Silica gel with new one similar to one's used in the existing transformer.

vii) Replacement of connecting cooling pipe, oil compensator (metallic bellows), butterfly/ball valve or any other accessories if found damaged or required by the Railways as per the joint initial investigation report conducted before to lifting of the faulty transformer.

viii) Painting of tank inside and outside using fire retardant

ix) Design and other technical parameters shall comply the requirement laid down in the Para 2.0 & 3.0 above.

x) BOM for the repair of the transformer shall be followed as per Annexure-I. Any deviation in BOM requires prior approval of RDSO.

8.0 In addition to above and for other requirements, if any, OEM's Transformer description, Instruction and Maintenance Manual No. XCH 199100-AUC, Rev 'D' or latest may be referred.

6/11/2012

(Sanjiv Swarup)
for Director General (Elect.)

Encl: As above.

Annexure- I

	Rev	Revision	Appd	Date

Sourcing Critical components – LOT 1250 for IRGP-194

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Sr.No.	Description	ABB LTD., INDIA	ABB SECHERON
1.	CTC conductor Nomex Insulated.	Asta/Invex/Samdong	Asta/Invex . Samdong is approved by ABB SECHERON.
2	PICC conductor Nomex Insulated	Shree Cable, Bhopal. Vidya wires, Anand.	Asta/Invex. Samdong is approved by ABB SECHERON.
3	Laminations for Core	27R115/M4 grade, Nippon Japan	27R115/M4 grade, Nippon Japan.
4	Press Board Insulation	Raw Material- Figeholm, Sweden Cutting- PUCARO FIGEHOLM Insulation Kit Centre (ABB subsidery Company)	Raw Material- Figeholm, Sweden
5	Nomex paper Insulation	Dupont, USA	Dupont, USA
6	Tank	Cimotec, Banglore	Cimotec, Banglore
7	Cooler (Structure & Air filter)	GEI Hamon, Bhopal. Ferrotic, Vadodara subject to RDSO approval	GEI Hamon, Bhopal
8	Heat Exchanger Drg.no.:- XCH204005-AUC	AKG Germany	AKG Germany
9	Fan Motor ABB HXF 100LB4/2- 0.4/1.6kw, 1440/2880 RPM , VIP Process, Class-H	ABB India	ABB India
10	Oil Pump 700 LPM, 10.8 M oil, 3HP, 2850 RPM VIP Process, Class-H	Flowwell , Banglore	Flowwell , Banglore
11	Temperature Sensor 2x PT100 Drg.no.:- 1ZCH101053-002	Altop Industries, Vadodara	AltopIndustries, Vadodara

13857

Based on -	Reg. No -	SOURCING CRITICAL COMPONENTS FOR TRACTION TRANSFORMER IRGP-194
Prepared HR GUJJAR / ABB LTD - INDIA	Responsible department EPPTR-TT-QA	
Approved VINCENT BRUNGARD / ABB SECHERON	Take over department -	Language En
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12	OverPressureValve Drg.no.:- 1ZCH101958-001	Sukrut Udyog, Pune / Atvüs, Kolkata	Sukrut Udyog, Pune
13	Flow detector Drg.no.:- 1ZCH102060-001	Honsberg, Germany	Honsberg, Germany
14	Oil level detector Switch	Honsberg, Germany	Honsberg, Germany
15	Oil level Indicator Drg.no.- 1ZCH101946-035	Sukrut Udyog, Pune	Sukrut Udyog, Pune
16	Ball valve 32NB/15NB Drg.no.: 1ZCH101029/ 1ZCH100020	Baroda Valves, Vadodara	Baroda Valves, Vadodara
17	Butterfly valve 80NB Drg.no.:- 1ZCH100072	Baroda Valves, Vadodara	Baroda Valves, Vadodara
18	Damper for Trafo.Mounting Drg.no.:- 1ZCH101982	Schwab, switzerland	Schwab, Switzerland
19	Transformer oil	Nitro-10XN from Nynas, Europe for first 4-6 units. There after Apar/ Savita make''Equivalent to Shell Diala-DX" as per IEC-60296 Approved by RDSO or Apar/ Savita make''Equivalent to Nitro-10XN" as per IEC-60296 Subject to RDSO approval	Nitro-10XN, Nynas, Europe as per IEC-60296
20	Elastimould Bushing- 36kV, 800A, 750S1 Drg.no.:- HSN420783	Elastimould, Switzerland	Elastimould, Switzerland
21	Gaskets for bushings		
21.1	NEBAR(Acrylic Nitrile Rubber)flat Gasket	James Walker & Co.Ltd., UK. RDSO Approved source.	Sourced from Europe

	Rev	Revision	Appd	Date

21.2	NBC (Nitrile bonded Cork Gasket)flat Gasket	Talbros Pvt.Ltd., Faridabad/ Nu-Cork Products, Gurgaon/ Cortica Mfg(I)Pvt.Ltd.,Chennai RDSO Approved source.	Sourced from Europe
21.3	NITRILE(Nitrile Rubber Vulcanised Butadiene) gasket	Bombay Oil Seal Company, Mumbai RDSO Approved source.	Sourced from Europe
22	Cover Gasket		
22.1	Expanded PTFE Drg.no.:- 1ZCH100003-005	ANGST + PFISTER SA, Switzerland	ANGST + PFISTER SA, Switzerland

Notes :-

1) All steel hardwares will be procured locally as per technical specifications of ABB Secheron.Sorces are Unbrako, APL, Kundan,Specialised components.
2) FRP Material will be procured locally from the sources approved by ABB Secheron. Namely, Volco Industries-Vadodara and Uniglass Industries Pvt.Ltd.-Bangalore.
3) Laminated wood insulating material will be sourced from M/s Permali Wallace - Bhopal as per the technical specifications of ABB Secheron.

Remark :-

1) This list is not permanent. ABB will inform to customer before any change of supplier on this list.

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Based on	Reg. No. -	SOURCING CRITICAL COMPONENTS FOR TRACTION TRANSFORMER IRGP-194	
Prepared HR GUJJAR / ABB LTD - INDIA	Responsible department PPTR-TT-QA		
Approved VINCENT BRUNGARD / ABB SECHERON	Take over department -		Langu age En
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Routine Tests on 1250 KVA EMU Transformer

REFERENCE SPECIFICATION:

The following international and national Standards are applicable:

- Rules for Traction Transformers and Reactors — IEC 60310 (2004)
- Rules for Electric Traction Equipment — IEC 60077 (1999)
- Specification for Electric Traction Equipment — BS 2618 (1975)
- Determination of transformer and reactor sound level — IEC 551
- Cooling oil — IEC 60296

Following routine tests shall be carried out on each transformer during routine inspection:

1.0 Preliminary checks
(in accordance with IEC 60310 Clause 10.2.3).

Check of the circuit diagram, terminal markings, polarities and particulars of the rating plates. Check of all dimensions as detailed in approved drawings and paint finish. In particular the surface of the components must be smooth and free of hollows. All welds are to be inspected.

Check the overall and mounting dimensions as detailed in ABB's drawing No. XCH199100-AUC, Rev 'C'.

Overall Length: 2697 ± 10 mm
Overall Width: 1988 ± 10 mm
Overall Height: 843 ± 10 mm

Fixing points: as detailed in the drawing No. XCH199100-AUC, Rev 'C'(copy enclosed)

2.0 Measurement of winding resistance
(In accordance with IEC: 60310, Clause 10.2.4)

The resistance of the winding between the connections has been measured at ambient temperature with direct current. Measured resistance of the winding shall not be more than the design value at 85 °C.

Winding	Measured resistance (m ohm) …. °C	Calculated resistance at 85 °C (m ohm) at 85 °C	Design value of resistance at 85 °C (m ohm) ± 5 % Guaranteed values
Primary(1U-1V)			9250
Traction 1(2U1-2V1)			15.50
Traction 2(2U2-2V2)			15.50

3.0 Measurement of Voltage Ratio (In accordance with IEC:60310, Clause 10.2.5)

The voltage ratios between pairs of windings has been measured for all accessible tappings of these windings. Measured voltage ratio shall be as under:

Winding	Measured voltage ratio	Designed voltage ratio ± 0.5% (as per IEC 60310 tolerance)
Primary(1U-1V) – Traction 1(2U1-2V1)		26.31
Primary(1U-1V) – Traction 1(2U2-2V2)		26.31

4.0 Measurement of no-load primary current and losses (In accordance with IEC:60310, Clause 10.2.6.1)

Measurement shall be made at rated frequency (50 Hz). The applied voltage will be sinusoidal with not more than 5% distortion. The measurement of the no-load current and losses shall be made for the rated traction voltage.

Guaranteed No load current(HV): 0.104 A + 30%

Guaranteed No load Loss: 1.00 KW + 15%

5.0 Measurement of load losses & impedance voltages (In accordance with IEC:60310, Clause 10.27)

The impedance voltage shall be measured with 50Hz sinusoidal supply with not more than 5% distortion. Short circuited terminal of the secondary windings i.e. 2U1-2V1 & 2U2-2V2 of the transformer. Adjust the voltage on the primary terminals 1U-1V such that rated current flows in the primary.

Guaranteed load loss(HV+Traction1+2 series) at 85°C = 49 KW + 15%
Guaranteed % Impedance : 39.4 ± 10%

6.0 Dielectric test

(In accordance with IEC:60310, Clause 10.2.11)

6.1 Separate source voltage withstand test :

A single phase separate source voltage shall be applied to the following winding with all other windings connected to tank + ground.

a)	HV winding	10 KV for 1 minute
b)	Traction 1 winding	5 KV for 1 minute
c)	Traction 2 winding	5 KV for 1 minute

6.2 Induced Overvoltage withstand test

The HV winding shall be subjected to 60 KV rms for 1 minute at a frequency of 100 Hz with 1U terminal raised to 60 KV and 1V terminal connected to earth. During the induced voltage test on a winding, care should be taken that the voltages induced in the various windings on the same magnetic circuit do not exceed the values given in Table 7 of IEC:60310.

7.0 Measurement of IR of Windings

Measurement of IR of individual windings to tank and earth and between windings shall be carried out at room temperature. IR values of the different windings shall be about 10'000 M Ohms or more. The values obtained after 15 & 60 seconds shall be recorded. IR 60 sec/IR 15 sec. shall be more than 1. For above measurement 5 KV megger shall be used. IR measurement test shall be repeated after HV test. Deviation in IR values measured after HV test shall be within 10% of the IR values measured before HV test.

8.0 Leakage Test on Tank

Pressure test on the transformer tank shall be carried out at a pressure of 0.4 Kg/cm2 over the normal head of oil for a period of 12 hours.

There shall not be any leakage.

9.0 Verification of test certificates of transformer oil and Measurement of BDV of transformer oil

Transformer oil shall be conforming to IEC:60296 and should be procured from the RDSO approved sources only. BDV of oil shall be more than 60 KV.

10.0 Measurement of Weight

Weight of transformer including oil and cooling unit shall be 3100 ± 3% Kg.