

**TECHNICAL SPECIFICATION FOR REPAIR AND TESTING OF
DAMAGED POWER TRANSFORMERS**

1.0 SCOPE:

This specification covers preliminary inspection, detailed assessment, estimation and complete repair, testing, safe custody and delivery of 5, 8 & 10 MVA, 37.5/11 or 33/11KV Power Transformers of assorted make and type lying damaged at various sites/workshop of PVVNL.

2.0 REPAIR WORKS:

The repair works shall involve the followings:-

- 2.1 Preliminary inspection of transformers at PVVNL site/workshop for minor & major repairs of transformers. Lifting from site, transportation and un-loading of transformers at contractor's works, opening of transformer cover, draining of oil, detanking of core and coil assembly, assessment and estimation for repairs, replacement of damaged parts, minor repair of core and tank, if required, cleaning, washing of dust and dirt etc from all parts including core, tank, cooling tubes of radiators, removal of damaged parts requiring replacement, fitting, fixing of new parts, making connection and assembly complete in all respects, retanking after repairs filling fresh transformer oil and making transformers ready and complete for testing as per clause "16.0 of Technical Specification, and loading of transformers at Contractor's works after satisfactory repairs and testing, transportation from his works to the PVVNL site/stores and unloading of transformer there of.
- 2.2 Painting and marking etc. as per clause 18 & 19 of 'TECHNICAL SPECIFICATION'. The charges for these works are to be specified in 'PRICE SCHEDULE'.

**3.0 MANUFACTURE/SUPPLY OF NEW SPARE PARTS FOR REPLACEMENT
OF DAMAGED PARTS**

- 3.1 This will involve supply/manufacture of parts such as HL/LV leg coils HV/LV bushings, Metal parts for HL/LV bushing set of gaskets, silica gel breather, oil level gauge, off load tapping switch & its handle, oil drain valve, Filter valve, Dial type thermometer, double Float bucholz relay, Air release plug, pair of arcing horns, radiator valve, replacement of OLTC contact, terminal barrier Board, replacement of gasket lubrication of mechanical system, providing insulation to un-damaged and healthy coil, core lamination, winding temp indicator complete set etc required for replacement of damaged parts. The rates for supply of such parts are specified in 'PRICE SCHEDULE'
- 3.2 The Contractor shall supply the 'SUNDRY ITEM' viz cover bolts, plug caps, screw washers, insulation material to be provided between HV/LV leg coils and inter phase lugs etc. Such as press pan board and ducts etc as required for replacement and Aluminium plate etc to be provided on repaired transformers.

Price of all above items including minor repairs of tank and all other small items not covered in 'PRICE SCHEDULE' elsewhere shall be treated to be included in price of sundry items of 'PRICE SCHEDULE'.

4.0 ATMOSPHERIC CONDITIONS:

The transformer after satisfactory repair and testing shall be suitable for operation in hot and humid climate conducive to rust and fungus growth. It can be used in indoor/outdoor under following conditions:-

(1) Altitude Not exceeding 1000 Meters.

(2) Climatic conditions:

- (a) Maximum ambient air temp 50 deg. C.
- (b) Max daily average ambient temp
 - In Shade 47.2 deg. C
 - In sun 65.5 deg. C
- (c) Minimum ambient air temp
 - in shade (-)5 deg. C
- (d) Relative humidity 100% max & 10% min
- (e) (e) Wind load 195 kg/Sq. mm
- (f) (f) Seismic level 0.3 g.
- (g) Iso Keronic level 50
- (h) Average annual rain fall 1200 mm

In case the original design is for different atmospheric climatic conditions the deviation to that extent shall remain applicable.

5.0 TYPE OF TRANSFORMERS TO BE REPAIRED:

5.1 The Power Transformers to be got repaired are 3 phase 50 hz, Oil immersed, self cooled transformers suitable for 1000 meters above sea level, Generally winding are connected in delta/Star so as to confirmed to vector group symbol Dyn-11. The transformers are generally constructed in accordance with ISS: 2026/1977 and any amendment thereof.

5.2 The transformers are having 'ON-AN' type cooling with either of the following alternatives:-

- (a) Cooling tubes radiator welded in transformer tank.
- (b) Detachable type fabricated radiator having separable plate valve between radiator and transformer body.

6.0 INSULATION LEVEL:

The di-electric strength of winding insulation and of bushing shall conform to IS:2026/1977 and any amendment thereof.

7.0 TEMPERATURE RISE:

The transformers shall be capable of operating continuously at their normal rating without exceeding temperature rise limits with maximum daily average ambient temperature of 45 Deg. C as specified below:

- (a) Winding temp rise 50 Deg. C by resistance measurement.
- (b) Oil (Hottest layer) 45 Deg. C by thermometer measurement.

8.0 TAP CHANGING SWITCH:

8.1 Wherever the tap changing switch requires replacement it shall be provided on HV winding with full capacity tap of OFF CIRCUIT pattern from 0 to (-) 15% in steps of 2.5%. These taps shall be controlled by hand operated OFF CIRCUIT external mechanism having suitable locking arrangement. Provision for indication of tap position shall also be suitably made. Necessary arrangement shall also be provided for locking the tap operating mechanism when in operation at any particular tap.

8.2 Wherever the ON load tap changing Switch requires replacement it shall be replaced with OFF circuit pattern full capacity tap changing arrangement on HV winding having

tapping as per original design of the transformer and other provisions as per Para 8.1 above. The rates for the above replacements shall be mutually agreed between contractor and concerned Superintending Engineer, Electy. Stores Circle after taking suitable credit of old OLTC with necessary approval from competent authority/committee as per PVVNL Rules and regulations.

9.0 CORE LAMINATIONS:

- 9.1** The core lamination if required to be used for repair of transformer core shall be of high grade low ageing low loss and high permeability silicon steel lamination especially suitable for transformers core. The tenderer shall quote price of core lamination in per kg. in 'PRICE SCHEDULE'.
- 9.2** After being sheared to size, the lamination shall be treated and provided with insulation which shall be inserted to the hot transformer oil.
- 9.3** After cleaning dust and dirt from the lamination the core shall be rigidly clamped or bolted as per the original design to ensure adequate mechanical strength and to prevent vibration during operation. The bolt used in the assembly of the core shall be suitably insulated and clamping structure shall be so constructed that eddy current will be minimum.
- 9.4** The core of the transformer shall be examined thoroughly during joint inspection and any defects thus found shall be rectified accordingly or if core found intact, it shall be cleaned of dirt and moisture. The joint inspection report on core should be very specific and clearly supported by joint certificate of its healthiness.
- 9.5** Rates for cleaning dust and dirt from lamination of core, as well as minor repair of core shall be included in the labour charges of the 'PRICE SHEDULE'.
- 9.6** Adequate and suitable provision shall be made to prevent movement of core and winding relative to tank during transportation and handling or in operation.

10.0 WINDING:

- 10.1** The damaged winding requiring replacement by new one, shall be identical to the original one. All new coil assemblies of identical voltage rating shall be interchangeable. The coil shall be supported between adjacent sections by insulating, DOVETAIL(locking arrangement) spacers and the barriers, bracing and other insulation used in the assembly of the winding shall be arranged to ensure free circulation of the oil and reduce hot spots in the winding.
- 10.2** All materials used in the insulation and assembly of the winding shall be insoluble, noncatalytic and chemically inactive in the hot transformer oil and shall not soften or change their basic properties under the operating conditions.
- 10.3** All threaded connections shall be provided with suitable locking devices. All leads from the winding to the terminals and bushing shall be rigidly supported to prevent damage due to vibration. It would be preferable to use sleeves wherever practicable.
- 10.4** The winding shall be clamped securely in place so that these will not be displaced or deformed during short circuits. In case there is no provision for tie rods in the clamping arrangement the same shall be provided in the repaired transformer without any additional charge. The assembled core and winding shall be dried in heating chamber till the proper megger value is received. The copper conductor used in the coil structure shall be best suitable to the requirements and all permanent current carrying joints in the windings and the leads shall be welded or rigidly clamped.
- 10.5** Winding replaced shall be fully insulated as per provision of IS-2026 or latest amendment thereof. All neutrals shall be insulated for full voltage as per IS-2026.

11.0 FREQUENCY:

The required transformers shall be suitable for continuous operation with a frequency variation of $\pm 5\%$ from normal frequency of 50 hz without exceeding permissible temperature rise.

12.0 PARALLEL OPERATION:

The repaired transformers of the same capacity voltage ratio and vector group shall operate satisfactorily in parallel among themselves, when connected across HV & LV busbars.

13.0 NO LOAD VOLTAGE RATIO:

The no-load voltage ratio of repaired transformers shall be same as that of the original transformers.

14.0 HIGHEST SYSTEM VOLTAGE:

The highest system voltage may be as high as 110% of the normal system voltage. The repaired transformers shall be suitable for continuous operation with this voltage on the HV side.

15.0 TRANSFORMER OIL:

The transformer shall be filled with fresh oil as used for the first filling. The oil shall conform to IS-335/1983 and any amendment thereof.

16.0 TESTS:

Each and every repaired transformers shall be subjected to all the routine tests as per ISS: 2026/1977 and any amendment thereof if applicable as detailed below:-

1. Measurement of winding resistance (cl.16.2 of part I)
2. Impedance voltage (cl.16.4 of part I)
3. Voltage ratio, polarity and phase relationship (cl.16.3 of part I)
4. Load losses (cl.16.4 of part I)
5. No load losses and no load current (cl.16.5 of part I)
6. Insulation resistance (cl.16.6 of part I)
7. Induced over voltage withstand (cl.11 of part III)
8. Separate source voltage withstand (cl.10 of part III)
9. Di-electric strength test on transformer oil as per IS-335/83 and any amendment thereof.

17.0 LOSSES:

Core losses should not be more than +10% of the value mentioned on the name plate of the manufacture and load losses should not exceed +5% of the value mentioned on the name plate of the manufacturer. In case name plate losses are not available the maximum permissible losses shall be as here under:-

SL. NO	CAPACITY (MVA)	LOAD LOSSES (KW)	NO LOAD LOSSES (KW)
1.	5	34.0	6.5
2.	8	48.0	7.0
3.	10	57.0	10.0

The tolerance of +5% in load losses and +10% in no load losses shall be allowed over the above figures.

In case nameplate of the transformer is not available it shall be duly certified in the joint inspection report.

18.0 PAINTING:

18.1 All metallic surfaces exposed to weather and requiring painting shall be given suitable priming coat and two coat of best quality paint of grey colour.

18.2 The inside of transformers shall be given suitable priming coat and two coats of best paint of zinc chromate or any other approved oil resistant which may not cause any chemical reaction with the transformer oil and result in deterioration of properties of the oil, whether the transformer is in operation or not. The radiator tubes and conservator shall also be painted from inside after proper cleaning.

19.0 MARKING:

19.1 After satisfactory repairs and testing the Contractor shall have to clearly print following details on the body of repaired transformers for the purpose of identification:

Repaired by M/s.
 Contract No. Date of PVVNL-MT
 Specification No. PVVNL-MT/MM/48(s)/22-23 Sl.No.....
 Inspected and testing on

19.2 Besides, the contractor shall have to weld a M.S. plates of suitable size on the body of the repaired transformers having punched following details:-

Repaired by M/s..... Contract
 No.....
 Specn. No. PVVNL-MT/MM/48(s)/22-23.....Dateof
 Sl.No
of PVVNL-MT
 Inspected & Tested on
 Date of expiry of guarantee.....

19.3 The contractor shall also fix aluminium plate of length 10cm and its width may be kept the same as that of original transformer manufacture's nameplate. This plate shall be fixed firmly by rivets (not by screw) on the body of repaired transformers just below the original manufacturer's name plate or any other suitable place if the same is not possible. The punched letters will be painted with good quality black paint for clear visibility. The details to be punched on the plate will be as per specimen given below:-

Sl. No.	Name of Repairer	Date of Repair *	Specn. No. of repair Contract & Sl.No.	Date of damage **
1.	2.	3.	4.	5.

Cost of above is deemed to be included in sundry items and no extra shall be made.

* Here the date of successful inspection by inspecting team shall be mentioned.

** To be punched by division to whom transformer pertains.