

1. Proper Foundation : Foundation must be strong enough to bear the load of transformer without any vibration and must be made with proper floor level and plinth level. Ram must be provided at the entrance. Height from the conservator to roof of the room should be 0.5 m below the lowest of the beam, if any.

2. Proper Spacing : Clearance as per I.S.I. rules should be maintained as follows :

- (a) If there is one sided wall, clearance must be 0.5 m.
- (b) If there is two sided wall, clearance from each side must be 0.75 m.
- (c) If there is three sided wall, clearance from each side must be 1m.
- (d) If there is four sided wall, clearance from each side must be 1.25 m.

3. Location of Switch Gear : The switch gears should be installed in a separate room. The power and control cables should be run in separate conduit pipes.

4. Proper Ventilation : Free circulation of air on all sides of the transformer and within the building must be maintained. The air inlets should be located as near the floor as possible and outlets at proper height to escape the hot air. Air inlets and outlets should be protected against the entry of water, birds etc. Exhaust fans should also be provided on the side wall of the room.

5. Proper Cable Trenches : The cable should be installed in proper trenches; conduits, duct or metal channels to protect them from being damaged.

6. Arrangement of Cable Boxes : Cable boxes should be provided with bushings for the termination of cable separately.

7. Provision for leaking oil : Provision should be made for proper drainage of oil leaking from transformers. Gravels should be spread all round. Proper slope should be made. Soakpits filled with sands and gravels should be provided with manhole.

8. Fire Protection C.T.C. : Carbon Tetra Chloride and foam type fire extinguishers and buckets filled with sand and water should be kept ready for the purpose. Automatic fire extinguishing system should be arranged for important transformers.

9. Noise Reduction : The transformer must be mounted on a non-reflecting resistance pad, on a solid and non-vibrating surface or reduce the noise level considerably.

Type-1. Typical Maintenance Schedule For Transformers upto 1000 KVA

Frequency of Inspection	Inspection	Inspection Details	Action Required if conditions are unsatisfactory
1. Hourly	Load (amperes) Temperatures, voltage	Check against rated figures	Start fans if necessary
2. Daily	Dehydrating breather	Check that air passages are clear. Check colour of active agent.	If silica gel is pink, charge may be re-activated for use again
3. Monthly	Oil level in transformer	Check transformer oil level.	If low, top up with dry oil. Examine transformer for leaks.
4. Quarterly	Bushings	Examine for cracks and dirt deposits.	Clean or replace

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5. Half-yearly	No conservator	Check for moisture cover.	Improve ventilation, check oil.
6. Yearly Oil	Oil in transformer	Check for dielectric strength and water content. Check for acidity and sludge.	Take suitable action to restore quality of oil.
"	Earth Resistance	—	Take suitable actions if earth resistance is high.
"	Relays, alarms, their circuits etc.,	Examine relay and alarm contacts, their operation, fuses, etc. Check relay accuracy etc.	Clean the components and replace contacts and fuses if necessary. Change the setting if necessary.
7. 2 Yearly	Non-conservator transformers	Internal inspection above core.	Filter oil regardless of condition.
8. 5 yearly or after internal fault.	—	Overall inspection, lifting of core and coils.	Wash by hosing down with clean dry oil.

Table-2. Recommended Maintenance Schedule For Transformers of Capacities of 1000 KVA and Above

Inspection Frequency	Items to be inspected	Inspection notes	Action Required if inspection shows unsatisfactory conditions
1. Hourly	Ambient temperature	—	—
2. Hourly	Winding temperature	Check that temperature rise is reasonable.	Shut down the transformer & investigate if either is persisting other than normal.
3. Hourly	Oil temperature	Check against rated figures.	—
4. Hourly	Load amperes voltage		
5. Hourly	Oil level in transformer.	Check against transformer oil level.	If low top up with dry oil, examine transformer for leaks.
6. Daily			
7. Daily	Oil level in bushing.	—	—
8. Daily	Leakage of water into	—	—

9. Daily	Relief diaphragm.	—	Replae if cracked or broken.
10. Daily	Dehydrating breather.	Check that air passage are free. Check colour of active agent.	If silicagel is pink, change by spare charge. The old charge may be re-activated again.
11. Quarterly	Bushing.	Examine for cracks & dirt deposits.	Clean or replace.
12. Quarterly	Oil in transformer	Check for dielectric strength and water content.	Take suitable action to restore quality of oil.
13. Quarterly	Cooler fan bearings, motors & operating mechanisms.	Lubricate bearings. Check gear box. Examine contacts. Check manual control & interlocks.	Replace burnt or worn contacts or other parts.
14. Half Yearly	Oil cooler.	Test for pressures.	—
15. Yearly (or earlier if the transformer can conveniently be taken out for checks.	Oil in transformer.	Check for acidity and sludge.	Filter or replace.
16. "	Oil filled bushings.	Test oil.	Filter or replace.
17. "	Gaskets	—	Tighten the bolts evenly to avoid uneven pressure.
18. 2 yearly	Cable boxes.	Check for sealing arrangements for filling holes. Examine compound for cracks.	Replace gaskets, if leaking.
19. 2 yearly	Surge diverter and gaps.	Examine for cracks and dirt deposits.	Clean or replace.
20. 2 yearly	Relays, alarms, their circuits etc.	Examine relay and alarm contacts, their operation, fuses, etc. Check relay accuracy etc.	Clean the components & replace contacts and fuses, if necessary. Change the setting, if necessary.
21. 2 yearly	Earth resistance.	—	Take suitable action, if earth resistance is high.
22. 5 yearly	1000 to 3000 kVA.	Overall inspection including lifting of core & coils.	Wash by hosing down with clean dry oil.
23. 7-10 yearly	above 3000 kVA.	— do —	— do —

Checking and Maintenance of Isolating switches

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Table 3.2 : Maintenance Schedule for Isolators

Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
Isolator to be disconnected from the system and both ends earthed. Clear the salt, cement or the acid fumes if accumulated on the surface of the insulators. Clean the insulator thoroughly	3 Months	—
Examine the contacts, inspect contact surfaces for correct alignment, any mark of corrosion or any abnormality.	— do —	If deep pitting or burning of contacts is found. the contacts should be immediately replaced. In case of minor pitting, contact surface should be smoothened with sand paper.

S. No.	Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
3.	Check the tightness of bolts, nuts, washers, cotter pins and terminal connections. The operating rods should be cleaned and lubricated. Check for simultaneous closing of all blades and making of contact fully in the closed condition of the isolator.	6 Months	—
4.	MECHANISM Lubricate output shaft bearing, auxiliary switch linkage, pin of emergency handle guard.	1 Year	Fill up oil if required (only recommended lubricants should be used).
5.	Apply a thin film of contact lubricant to auxiliary switch contacts.	—	Replace the auxiliary contact if found defective.
6.	Check electrical components, ensure contactor operates freely. Check all electrical connections, fixing bolts, split pins etc. Check up functioning of all auxiliary relays inside the mechanism.	— do —	Remove and replace if any item is found defective.
7.	Check IR values of driving motors	— do —	—
8.	Measure contact resistance of each pole by passing DC current	— do —	Compare with test values and if high, adjust the contacts and contact pressure,
9.	Check pick-up values of operating coils.	— do —	Replace if necessary.
10.	EARTH SWITCH : Check the tightness of earth connections, bolts, nuts, washers etc. The operating rods to be cleaned and lubricated.	6 Months	Tighten, if any bolt/nut is noticed loose.
11.	Clean the surface of insulators thoroughly to avoid possibility of flash over.	6 Months	Clean the surface with soft dry wiping rags, wet or paraffin soaked cloth. If these methods are ineffective, 10% strong HCL can be used. In this, necessary precautions for its use may be observed.

S. No.	Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
12.	Examine contacts, inspect contact surfaces for correct alignment, corrosion mark or any other abnormality.	— do —	Remove and replace in case any contact is found damaged.
13.	Check for simultaneous closing of all blades and complete making of contact in the closed condition. Ensure that earth switch does not close when isolator is in closed condition	— do	—
14.	Check the working and alignment of auxiliary switches.	— do —	If necessary, make adjustments.
15.	Check manual working of the isolator with hand lever.	— do —	—

(ii) HT/LT Circuit breakers

Table 3.3 : Maintenance Schedule for Minimum Oil Circuit Breakers

S. No.	Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
1.	Checking of oil level in each interrupter	Weekly	If the oil level is low, top up the oil
2.	Checking of visible oil leaks	— do —	If any oil leakage is observed attend to the same.
3.	Checking of heater function	3 months	Replace the damaged/defective heater
4.	Visual inspection of breaker and operating mechanism	— do —	Replace the damaged/broken parts, fix the loose parts properly. Exposed metal parts should be protected by a thin coating of rust preventing oil/grease after defrosting. If dust collection is excessive cleaning with non-fluffy cloth at the earliest opportunity is essential. For removing oil/grease and carbon deposit, use Acetone.

S. No.	Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
5.	Checking of breaker operation and removal of coating developed on current carrying parts	- do -	Breaker should be operated electrically from local and remote controls a few times on no load with isolators on both sides open. Tripping of breaker with mechanical push button should be checked. In this process any coating developed between the sliding surfaces will get removed.
6.	Cleaning of Porcelain bushings	- do -	Clean the bushings. Period may be reduced in case of highly polluted atmospheric conditions.
7.	Checking of oil leakage from oil dash pot in operating mechanism	- do -	Replace the damaged/ defective O-rings in the event of any oil leakage.
8.	Checking of dielectric strength of oil	Quarterly or after 4 major or 10 medium or 1000 interruptions at rated normal current	Filtering/replacement of oil is essential if withstand value is less than 40 KV.
9.	Checking of contacts burning.	- do -	If burning slight, removing the burn beads and polishing the surface are sufficient. Replace the tips and arcing ring when burning is heavy. Make sure that the contact surface at the joint is clean and loosening and tightening of tips a few times before final tightening is done.
10.	Checking of extinguishing chamber.	- do -	Extinguishing chamber should be removed from the breaking unit and rinsed with transformer oil keeping the rinsed with transformer oil keeping the chamber 'upside down'. If the condition of any part indicates severe burning dismantle the chamber replace the burnt/damaged parts.

Table 3.5 : Maintenance Schedule for Lightning Arresters

	Work to be carried out	Periodicity	Action required if inspection shows unsatisfactory condition
	Reading of the surge counter	3 Months	Normal counting rate is 0 – 5 counts a year. More than 10 counts is abnormal but can be explained with a lot of known switching operations or increased contamination. In case of contamination each the arrester as soon as possible. Counts of the order of 100 per year indicate low spark over voltage due to internal arresters faults. In such cases the arrester have to be changed. But before replacing the L.A; health/correctness of the surge counter must be established.
2.	Cleaning of the surge arrester	6 Months	—
3.	Measurement of insulation Resistance	— do —	Measure insulation resistance after cleaning the surface of the insulator. The basic value should be more than 1000 M ohm with a 1000 V Megger. Any value below this should be deemed to be abnormal.
4.	Measure Earth resistance and check earth connections.	— do —	—
5.	Grading current measurement. Measure the grading current in the following ways :	Yearly	A change of grading current of more than 50% (at constant voltage) indicates faulty arrester which should be changed.
	(i) Check with current leakage meter.		
	(ii) In case current leakage meter is not available, connect a high ohmic (≥ 1 M. ohm) voltmeter across the surge counter which constitutes a capacitive shunt. The voltage to be measured is of the order of a few volts and is proportional to the grading current. However, a faulty surge counter may give rise to voltages of some KV at the arrester side of the surge counter. Therefore, always connect the voltmeter to the surge counter terminal with an insulated stick. Comparison		