

# INTRODUCTION

## What Actually Maintenance is ?

The work of maintenance consists of routine inspection, testing, cleaning and adjustments which are carried out on a piece of equipment in service to avoid its breakdown. Maintenance should not be confused with repair work which is carried out after the breakdown of the equipment in service, to restore it to its working condition and unlike maintenance, cannot be given careful advance planning. In brief, the quantum of any maintenance work will basically cover the following :-

- 1) Inspection.
- 2) Preventive Maintenance
- 3) Overhauls

These are further illustrated below :-

### Inspection

It signifies a visual check of equipment without physical disassembly. Periodical inspection of equipments when in operation provides a check on their conditions, reveals the faults and defects which may develop during operation and makes it possible to take timely remedial measures.

### Preventive Maintenance

It signifies the periodical work including operational and any other testing on a piece of equipment to its suitability in service and to maintain it in proper working condition. It is scheduled on the basis of data obtained through inspection and maintenance checks giving priority to the troubles threatening normal operation of the line/equipment.

### Overhauls

It signifies preventive maintenance involving major disassemble of the equipments. It is scheduled on the basis of normal life expectancy of the equipment or when the need arises on the basis of data obtained through inspection and maintenance checks.

Following “Inspection”, there are two important actions, namely “Reporting” & “Rectification”. Unless deferrable for the regular periodic maintenance, any defects observed during the inspection should be rectified within the shortest possible

time in order to avoid its development into a major fault. In any case, the observations of inspection should be recorded and reported in a suitable form for follow-up action.

For this purpose, proforma of “Inspection Reports” for various equipments/components of the distribution system have been prepared (Annexure I - V) which can be easily filled up and interpreted by the Field Staff. To facilitate reporting with use of minimum words, the various equipments/components of the distribution system have been divided into the following main heads/chapters :-

1. Distribution Transformers.
2. a) 11 KV Overhead Lines (Including 11 KV G.O. Switches)  
b) 11 KV U.G. System (Including RMUs.)
3. LT Lines.
4. Service Connections.

These main-heads have been further divided into appropriate sub-heads and all likely defects that can occur on these sub-heads have been described in inspection schedule. For example, the sub-heads for the main head No. 2 A. i.e., (11 KV overhead lines) shall be pole, stays, crossarms, conductor, insulator, jumper, G.O. Switch, earthing etc. Then all the likely defects which occur on these equipments have been listed under the inspection programme. For example, consider the case of insulators. The defects listed in inspection programme are :-

Main Head No. 2 A.      11 KV overhead lines.

Sub - Head

Insulators and Fittings :

- 1) Broken or chipped porcelain
- 2) Tilted insulator
- 3) Excessive deposits of dust/coal etc.
- 4) Excessive rusting.

So, while inspecting the insulators of 11 KV line, the Field Staff will check for the above listed defects in the insulators and their fittings. If there are no defects, the Field Staff will tick (✓) in the space against the column of “Insulator” provided in proforma for “11 KV line Inspection Report”. And, if there is some defect, he will write the defect details in this space, e.g., insulators are tilted. In the remarks column, he would state whether it needs immediate attention (I. A.) or can await the periodic maintenance.

Such inspection reports should be prepared in triplicate by the Field Staff and given to Section Officer. The Section Officer should keep a continuous check to ensure that rectification is being carried out in respect of all “Inspection Report’s submitted to him. Those defects, observed during inspection which could await till periodic maintenance may be recorded in the equipment maintenance registers, so that these are also rectified while carrying out preventive maintenance. The Section Officer should send inspection report copy to the Sub-Divisional Officer marking the defect no. in the space provided, e.g., if the Field Staff has reported 11 KV Line Insulator tilted he will write 2 A d(ii) in the inspection report. The Asst. Engineer, (Technical) of the Sub-Division should monitor the action taken by the Section Officer on the observations made in the Inspection Report.

On the basis of these main-heads, the various components of the distribution system have been divided into Five (5) chapters, and for the convenience of the staff, the instructions for inspection, maintenance and overhauls for each of these components, have been described in one separate chapter.

It is also very much desirable to maintain history sheet for all Distribution Transformers & RMUs. Suitable proforma to serve as history sheets for Distribution Transformers & RMUs have been prepared and are included in this Manual. It will keep a complete and up-to-date record of all the inspections, periodic maintenance, overhauls & repair work done on a particular Transformer & RMU, which will facilitate the effective and efficient working of maintenance programme. All subsequent movements of the equipment after its initial installation shall be properly maintained by the Section Officer.

It would be worthwhile to mention here that the schedule recommended in this manual are just guidelines which represent minimum basic recommendation for maintenance programme on electrical equipments exposed to “normal operating conditions”. It is, therefore, to be noted that the equipment :

- 1) Operating beyond its normal life expectancy
- 2) Or, in an unusually severe environment.
- 3) Or, Subjected to abnormal operating duty, have to be given special considerations over and above that are recommended in the schedules. In addition to the above, the maintenance schedules may sometimes need

modification / alterations in view of the manufacturers instructions in case of a particular equipment and required standard of reliability for a particular system.

### **Important Guidelines for Making the Schedules Effective:-**

We are confident that these maintenance schedules, if followed in the field, are sure to bring out improved results by way of reduction in supply interruptions and increase in life of various equipments. It will also increase the cost effectiveness and efficiency of maintenance programme of the electric utilities.

However, the following general instructions must always be followed to ensure successful implementation of the maintenance schedules:-

- 1) In case of newly erected lines, the same must be inspected thoroughly after rains during first year of their service.
- 2) The minor defects noticed during inspection must be attended, wherever possible, and other cases at the earliest possible occasion after chalking out a programme in advance.
- 3) In case of occurrence of any abnormal conditions the equipments should be immediately disconnected from service and matter reported to higher authorities for further instructions.
- 4) Manufacturers' instructions should always be given due consideration while carrying out maintenance of a particular equipment.
- 5) A continuous record of all test results should be maintained.
- 6) Suitable inspection and maintenance charts / history sheets should be maintained giving complete details for all inspection and maintenance work done and further proposed to be done so as to facilitate proper and effective working of the maintenance programmes.
- 7) Required safety precautions / safety devices must be observed / used while carrying out any maintenance works.
- 8) The schedules once adopted should be subjected to periodical review in the light of previous experience to see if improvements are possible not only to ensure adequate maintenance, but also to reduce costs.

### **Off-Schedule Inspection**

To maintain the system at the required level of operational reliability, it is essential to further carry out the inspections of the following nature apart from the scheduled inspections already discussed:-

**1) Special Inspections**

These inspections are recommended to be made after severe weather conditions, i.e., wind storms, heavy rains, thunderstorms etc., so as to detect any damage or breakage on the line / equipment and to take necessary action.

**2) Night Inspections**

The inspections of this nature are necessary to detect surface leakage, overheated conductor joints and sparking switches, etc., as these are not generally visible during the day time.

**3) Emergency Inspections**

Such inspections are required over a line during its breakdown to locate and identify the cause of trouble as early as possible in order to restore the supply. Separate emergency staff should be kept for this purpose.

**4) Follow-up Inspections**

These inspections are required over a line following one or more short interruptions on it (though with the supply restored) to locate and identify the cause of interruption and to make an estimate of the amount of maintenance required.

**5) Check Inspection**

These include the inspections carried out by the engineers-in-charge of maintenance, as a check on the conditions of line and the efficiency of the patrolling staff and to point out the defects which could not be noticed by the staff in the first instance.

## **CHAPTER - 1**

# **DISTRIBUTION TRANSFORMERS**

### **1.1 RECOMMENDED SCHEDULES FOR INSPECTION**

<b>Frequency of Inspection</b>	<b>Equipment / Items to be Inspected</b>	<b>Points to be checked / noted</b>	<b>Remarks</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
Quarterly	a) Supports	Check for proper supporting and level of the transformer	<p>Refer Table - I for fuse ratings.</p> <p>Incase of appreciable leakage of oil, check up its level and top up, if necessary with tested oil</p>
Quarterly	b) Connections	Check for tightness of connections	
Quarterly	c) Fuses (HT & LT)	<ol style="list-style-type: none"> <li>1. Check for tightness &amp; continuity</li> <li>2. Check for correct ratings</li> </ol>	
Quarterly	d) Oil	<p>Check for leakage of oil</p> <ol style="list-style-type: none"> <li>1. From drain off valve</li> <li>2. From gaskets</li> <li>3. From tank leak etc</li> </ol>	
Quarterly	e) Bushings	Check for chipped & broken procelain	
Quarterly	f) Arcing horns	<p>Check for the following :</p> <ol style="list-style-type: none"> <li>1. Any damage due to flash over</li> <li>2. Correct alignment and proper gap adjustment between</li> </ol> <p>Arcing rods (Gap 3.2 cm. for 11 KV)</p>	

Frequency of Inspection	Equipment / Items to be Inspected	Points to be checked / noted	Remarks
1	2	3	4
Quarterly	g) Breather	<p>Check for the following :</p> <p>a) Colour of the silicagel</p> <p>b) Opening of the breathing-in-passage</p>	<p><b>Colour of good silicagel is blue</b></p> <p>Recondition it if the colour has changed. The Silicagel must be roasted in a pan such that the colour changes from Pink to Blue.</p> <p>Refer Table - II for Grounding Conductor Size/Type.</p>
Quarterly	h) Earthing	<p>Check for the following:</p> <p>1. Tight and intact earth connections of the body &amp; neutral of the transformers</p> <p>2. Proper size of grounding conductor</p>	
Quarterly	i) Danger Plate & Anti- Climbing Devices.	<p>1) Proper supporting of Danger plate at a suitable height from the ground level &amp; facing in the right direction.</p> <p>2) Check whether Anti climbing Devices are provided or not</p>	
Quarterly	j) Explosion vent diaphragm	<p>Check, if cracked or broken</p>	
Quarterly	k) General conditions nuts	<p>Check for general cleanliness and tightness of all bolts,</p>	
Quarterly	l) LT Switch / LT protection kit	<p>Check for the following:</p> <p>1. If the switch with cover is intact</p> <p>2. If the cable / switch is running hot</p> <p>3. Signs of overheating / burning on contacts</p> <p>4. Size of the LT Leads are of adequate capacity</p> <p>5. Proper size of fuse wire</p> <p>6. Safety from rain water etc</p>	<p>If the Capacity of the Transformer is more than 100KVA, provide LT Distribution Box</p>

Frequency of Inspection	Equipment / Items to be Inspected	Points to be checked / noted	Remarks
1	2	3	4
Quarterly	m) Lightning arrestors	<p>Check for the following</p> <ol style="list-style-type: none"> <li>1. Broken / damaged porcelain</li> <li>2. Intact and tight line earth and connection</li> <li>3. External indication of fused / spark over voltages</li> </ol>	
Quarterly	n) G.O. Switches	<p>Check for the following:-</p> <ol style="list-style-type: none"> <li>1. For smooth operation</li> <li>2. Evidence of over-heating, burning, corrosion / pitting on the switch contacts</li> <li>3. Broken or damaged insulators</li> <li>4. Proper and tight earth connections</li> <li>5. Proper alignment of switch contacts</li> <li><b>6. All the 3 blades are opening and closing simultaneously</b></li> <li>7. Proper and complete fitting of male contacts into the female ones</li> <li>8. Arcing horns are intact</li> </ol>	

## 1.2 RECOMMENDED SCHEDULES FOR PREVENTIVE MAINTENANCE

**Note:-** The steps already recommended under schedule of inspection should be considered in addition to the points given below

Frequency of Inspection	Equipment / Items where maintenance is to be done	Details of maintenance Work to be done	Remarks
1	2	3	4
Half Yearly	a) Connections	1) Tighten connections, replace worn out bolts & nuts	
Half Yearly	b) Fuses	Replace the old fuses with new ones of right capacity	1) The fuse wires get thinned out with passage of time due to ageing effect. 2) For deciding ratings, Refer to Table - I
Half Yearly	c) Oil level	1) Observe the colour of the oil to have an idea of its conditions 2) Check for proper oil level against the gauge glass. Top up, if necessary with good tested oil 3) Stop any leakages	Charge the Transformer two hours after topping up of oil
Half Yearly	d) Bushing and Arcing	1) Clean off all dirt, paint and other deposits 2) Examine and replace the cracked / broken or chipped bushings 3) Examine and replace the damaged Gasket. 4) Adjust the arcing horns for alignment and proper gaps between them	Gap 3. 2 cms for 11 KV bushings

Frequency of Inspection	Equipment / Items where maintenance is to be done	Details of maintenance Work to be done	Remarks
1	2	3	4
Half Yearly	e) Breathers	1) Check for condition / colour of silicagel. Recondition or replace as necessary 2) Fill the silicagel upto top of the container 3) Open and clean the air-in-passage if choked by paint, dust etc. 4) Tighten the lid of breather for air tightness to avoid entry of moist air	Always ensure that the colour of Silica gel is <b>Blue</b> .
Half Yearly	f) Voltage	Measure the voltage during maximum load period & adjust the taps, if required, to ensure proper voltage to the consumers	
Half Yearly	g) Danger Plate & Anti Climbing Devices.	1) Replace the danger plate, if defaced 2) Provide Anti Climbing Devices wherever necessary	
Half Yearly	h) General Conditions	Clean off all dirt etc from the body of the transformer and tighten all bolts / nuts etc.	
Half Yearly	i) L. T. Switch and L. T. Protection Kit.	1) Check load on the LT circuit & replace the LT cable/LT switch by higher capacity one where Necessary 2) Replace the damaged LT cable with new one of right capacity	If the Capacity of Transformer is more than 100 KVA , provide LT distribution Box

Frequency of Inspection	Equipment / Items where maintenance is to be done	Details of maintenance Work to be done	Remarks
1	2	3	4
Quarterly	j) Load Balancing	<ol style="list-style-type: none"> <li>3) Examine the switch for smooth operation</li> <li>4) Recondition the switch</li> <li>5) Tighten all connections</li> <li>6) Ensure that the inlet of the cable into the switch is plugged with plastic compound to avoid entry of rainwater</li> <li>7) Check for loose connection &amp; signs of overheating of conductors at clamp connection to LT protection kit</li> <li>8) Replace old fuses with new ones of Right type, Capacity &amp; Proper Length</li> <li>1) Check load on three phases with the help of clip-on-ammeter under maximum load conditions and ensure load balancing on all the three phases</li> </ol>	<p>Use 240 sq. mm LT Cable Leads of Two Runs for 250 KVA and Four Runs for 500 KVA Transformer Centres</p> <p>For deciding ratings refer to Table - I.</p> <p>In case of overloaded Transformer reduce the load by transfer of load. Augment the transformer or provide additional transformer if the overload is substantial and constant</p>

Frequency of Inspection	Equipment / Items where maintenance is to be done	Details of maintenance Work to be done	Remarks
1	2	3	4
Half yearly	k) G.O. Switch	<p>1) Cleanliness :- Clean all dust &amp; other deposits with neat and dry cloth</p> <p>2) Insulators :- Check for cracks, chipping &amp; other defects, replace where necessary</p> <p>3) Switch Contacts :-</p> <p>a) Check for alignment, adequate contact pressure and smooth operation &amp; adjust where necessary &amp; grease the contacts</p> <p><b>b) If One of the contact is faulty replace the G. O. S. immediately.</b></p> <p>c) Examine for burning / over-heating or other damages. Recondition or replace, where necessary</p> <p>4) Arcing Horns:- Check if they are intact and replace, if damaged / burnt</p> <p>5) Mechanism:- Clean, examine and review worn-out parts. Relubricate and check for correct operation</p> <p>6) Main connections:- Proceed as described under separate heading of “Jumpers”</p>	

Frequency of Inspection	Equipment / Items where maintenance is to be done	Details of maintenance Work to be done	Remarks
1	2	3	4
Half yearly	l) Earth Testing (Should be done during the driest part of the year)	7) Examine General Condition of the conductor and earthwires i.e., for crushed spots, kinks over / under-tensioning etc. and recondition where necessary 8) General:- Check all hardware and tighten, if needed 1) Tighten the earth connections of Neutral, Body and L. A. 2) Examine and replace broken earth leads / conductors with proper size 3) Provide Additional Grounding wherever necessary	Refer Table - II for Grounding Conductor
Half yearly	m) Lighting Arrestors	Clean and examine insulators for cracks or flashover. Replace, where necessary	

### 1.3 RECOMMENDED SCHEDULES FOR OVERHAULS

Frequency of overhauls	Equipment / Items where maintenance is to be overhauled	Details of the work to be done	Remarks
1	2	3	4
Five Yearly	a) Distribution Transformer	Insulating oil should be filtered and transformer body be repainted	

### GENERAL GUIDELINES

#### 1) 11 KV OVERHEAD LINES :-

On account of the existing lengthy lines in our systems it is desirable to bifurcate the lines into different sections namely Trunk Line Sections / Spur Line Sections to follow the maintenance procedures enumerated in the Chapters of the Maintenance Manual for effective / easy implementation.

The General procedures for codification of Line for identification is as follows:-

1) Single line diagram of all the feeders starting from the MUSS / Feeding Point to the end point of the jurisdictional area of the O&M section incorporating the details are to be drawn for identification of the system components:-

- A) Name of the MUSS.
- B) Feeder Name/No.
- C) Trunk Line/Spur Line
  - 1) Name
  - 2) No of poles
  - 3) No. of TC's

D) Peak load of the feeder.



**NOTE:-**

1. In case of Double Circuit, the Pole Numbers have to be prefixed with the Feeder Number.
2. Poles at the Transformer Centre are not to be numbered.
3. If the length of span is more than 50 mtrs. Provide intermediate poles.
4. If No. of Joints in a Span is More than two, replace the Span Conductor.

**1. 11 KV U.G. SYSTEM :-**

Keep record of Cable Route Map of all the Feeders indicating the following details:-

1. Sources of Supply.
2. Size /Type / Length of the Cable.
3. Load Details.
4. Location of Joints.
5. Details of RMU's and Transformers.

# CHAPTER – 2

## 2A. 11 KV OVERHEAD LINES (INCLUDING 11 KV G.O.SWITCHES)

### 2A - 1. RECOMMENDED SCHEDULES FOR INSPECTION

Frequency of overhauls	Equipment / Items to be inspected	Points to be inspected	Remarks
1 Quarterly	2 a) Poles 1) Steel 2) Wood 3) Cement	3 Chek for the following incase of all the 3 types of poles: 1) Damaged/broken poles or for ground level erosion and corrosions where the pole is not capable of safely supporting its load 2) Bowed or leaning poles due to improper guying or overloading 3) Unauthorised attachments such as fencing, Aerial wires etc 4) Poles are very much exposed to accident due their being near or in common way 5) Condition of foundation	4

Frequency of overhauls	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
Quarterly	a) Stays	<p>Check the following:</p> <ol style="list-style-type: none"> <li>1) Correct direction and proper angle of the stays</li> <li>2) Loose, broken or any other damage done to stays</li> <li>3) Whether stay insulator is intact/whether stay is properly earthed</li> <li>4) If stay - rods are corroded</li> </ol>	
Quarterly	a) Cross Arms	<p>Check the following:</p> <ol style="list-style-type: none"> <li>1) If the Cross arms / Clamps have slipped</li> <li>2) Bending of Cross arms due to uneven tension</li> </ol>	
Quarterly	b) Insulators and Fittings	<p>Check the following:</p> <ol style="list-style-type: none"> <li>1) Broken or chipped porcelain, flash over marks</li> <li>2) Tilted insulators</li> <li>3) Excessive rusting of fittings</li> </ol>	
Quarterly	c) Conductors	<p>Check the following:</p> <ol style="list-style-type: none"> <li>1) Examine, if severely tied to the insulator/pole/ Crossarm</li> <li>2) Proper sag</li> <li>3) Proximity of trees and other objects including building etc</li> <li>4) Sufficient clearances between conductors And earthwires, and also from the ground</li> </ol>	

Frequency of overhauls	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
Quarterly	a) Jumpers and Other Accessories	<p>5) Sufficient clearances from other electric/ telephone lines passing along, below or above it</p> <p>6) If joints in the jumpers and conductors appear alright</p> <p>7) Broken conductor strands</p> <p>8) Binding wire has not become loose and open</p> <p>9) All joints and jumpers of aluminum conductor have proper P. G. Clamps</p> <p>10) More than Two Joints in a Span</p> <p>11) Loose Spans</p> <p>Check for the following:</p> <p>1) Proper supporting &amp; jointing two ends of the jumpers with P.G. Clamps</p> <p>2) Sufficient clearance between jumpers on the 3 - phases</p> <p>3) Sufficient clearance of jumpers from metal works / stays, so as not to swing close enough to strike an arc</p> <p>4) Provision of proper insulation of jumpers</p> <p>5) Signs of over-heating and burnings on jumpers and other fittings</p> <p>6) Loose / Defective Clamps, Jointing Sleeve, Bolt and Nuts etc</p>	

## 2A - 2 RECOMMENDED SCHEDULES FOR PREVENTIVE MAINTENANCE

**Note:-** The steps recommended below are to be carried out in addition to already pointed in-respect of various equipments under inspection programme.

Frequency of Maintenance	Equipment / Items whose maintenance required	Details of maintenance work to be done	Remarks
1	2	3	4
Within One Month after Inspection (Also before and after Monsoon)	a) Poles 1) Steel 2) Wood 3) Cement	The instructions given below are common to the 3 types of poles: 1) Replace the damaged / broken poles 2) Straighten / make vertical leaning poles by proper guying 3) Shift the position of poles exposed to accidents due to their being near or in common way 4) Pack and consolidate the foundation soil, where disturbed or erod	
Annually	a) Stays	1) Tighten the loose stays 2) Replace the broken / damaged stays and stay bows 3) Replace the broken stay insulator / recondition the earth 4) Provide Stays wherever required to avoid yielding of poles during monsoon	
Annually	b) Cross-arms	1) Replace the broken / cracked / bent cross-arms by new ones 2) Bring in position the slipped crossarms / clamps	

Frequency of Maintenance	Equipment / Items whose maintenance required	Details of maintenance work to be done	Remarks
1	2	3	4
Annually	c) Insulators	1) Clean and check for cracked / chipped and Punctured insulators. Replace, where necessary	The insulators be checked twice a year preferably before and after monsoons
Annually	d) Conductors1)	Tighten loose bindings and replace 2) Examine for corrosion at the joints of conductors and insulators. Clean and renew, where necessary 3) Examine closely for broken strands, particularly at insulators, clamps, due to vibration & repair where necessary 4) Examine for slipping of conductors from the clamps. Tighten all clamps & fittings	
Annually	e) Jumpers and line accessories	1) Check for broken or burnt strands of the jumpers & replace where necessary 2) Check for proper material & size of the jumpers for the given conductors 3) Check for crowding or jumbling of wires and jumpers at the tee-off points and adjust, where necessary. 5) Replace the binding wire joints of jumpers by proper P. G. Clamps	

Frequency of Maintenance	Equipment / Items whose maintenance required	Details of maintenance work to be done	Remarks
1	2	3	4
<p>Quarterly (Its maintenance may be done even earlier as the functioning of GOS is generally in disorder and is always a source of trouble).</p>	<p>g) G. O. Switch</p>	<p>1) Cleanliness:- Clean all dust &amp; other deposits with neat and dry cloth  2) Insulators:- Check for cracks, chipping and other defects, replace where necessary  3) Switch Contacts:-  a) Check for alignment, adequate contact pressure and smooth operation and adjust where necessary  b) Examine for burning / over-heating or other damages. Recondition or replace, where necessary  4) Arcing Horns:- Check if these are intact and replace and smooth operation and adjust where necessary  6) Mechanism:- Clean, examine and review worn-out parts. Relubricate and check for correct operation  <b>6) If One of the legs is faulty, replace the G.O.S. immediately.</b>  7) Main connections :- Proceed as described under separate heading of “Jumpers”  8) Examine General Condition of the conductor and earthwires i.e., for crushed spots, kinks over/under-tensioning etc. and recondition where necessary  9) General :- Check all hardware and tighten, if needed</p>	4

<p>1</p> <p>Every 3 Months (Once before the monsoons and secondly after monsoons or earlier if necessary)</p>	<p>2</p> <p>h) Tree trimming</p>	<p>3</p> <p>Cut off the tree branches where necessary to maintain a minimum clearances of 1.8 m on each side of the line</p>	<p>4</p>
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## **2A - 3 RECOMMENDED SCHEDULES FOR OVERHAULS**

Periodic overhauls are not required for components of 11 KV Line and preventive maintenance at regular intervals is sufficient.

## 2-B 11 KV U.G. SYSTEM (INCLUDING CABLE, RMU's)

NOTE :-THESE INSPECTIONS ARE TO BE UNDERTAKEN ONLY UNDER PROPER LINE CLEAR AND DULY OBSERVING ALL SAFETY MEASURES.

### 2-B-1 RECOMMENDED SCHEDULES FOR INSPECTION

Frequency of Inspection	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
Quarterly	a) General Cleanliness	1) Examine the Switchgear premises, the doors, locks & OCB for overhaul conditions & general cleanliness. 2) Check the RMU for vermin proof, weather proof & water proof 3) Clean the surrounding of the RMU	If any defect is noticed take appropriate action immediately  Refer Table-II for Grounding Conductor Size / Type
Quarterly	b) Auxillary Fuses	Check that the fuses are intact and are of correct rating	
Quarterly	c) Eathing	Check for tight & proper earthing connections of all metal parts & Electrode	
Quarterly	d) 11 KV Cable	Observe the Cable route of H.T.U.G. Cable and take precautionary action to prevent damages by external agencies like P & T, Water Supply	
Quarterly	e) Paint and Danger Plate	1) Check for proper supporting of danger plate at suitable height from the ground level and facing in the right direction 2) Check for the following details painted on RMU is clearly visible or not a. Name of the Incoming and Outgoing Source with reference to Source of Supply & Cable Size b) Contact Tel. No. and Office incase of Emergency In Bold letters	

Frequency of Inspection	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
Quarterly	f) 11 KV Cable At RMU  g) Circuit Breaker <b>1. VL / BOCB</b> a. Insulators & Bus bars  b. Contacts  c. O.C.B. Tank	Check for the following :- 1. Tight & intact connections 2. Over all conditions of the cable & end termination 3. Insulation taping of end termination  1. Draw out Breaker and Clean Breaker Insulator 2. Clean Bus bar and Bus supporting Insulator 3. Clean Spout Grid inside and outside with petrol  Check operation of the fixed and moving contacts  Examine the following :- 1. Signs of local heating 2. Any unusual smell/noise  1. Clean insulated housing switch bushing insulator and all other insulating parts with petrol 2. Clean Bus and cables side spout insulator with petrol  Check lowering and raising operation of the breaker and opening of the shutters  Check for condition of V.I  a. Clean bus-bars & bus supporting insulators	4
Quarterly	<b>2. V.C.B.</b> a. Insulators  b. Operating Mechanism  c. Interrupters (V.I)  <b>3. On Load Oil Isolator (O.D)</b> a. Insulators & Bus-bars  b. Contacts	b. Check operation of the fixed and moving contacts	Refer VCB Manual

## 2B-2. RECOMMENDED SCHEDULES FOR PREVENTIVE MAINTENANCE

- Note:-** 1) The steps recommended below are to be carried out in addition to already pointed in-respect of various equipments under inspection programme.
- 2) THESE INSPECTIONS ARE TO BE UNDERTAKEN ONLY UNDER PROPER LINE CLEARLY AND DULY OBSERVING ALL SAFETY MEASURES.

Frequency of Maintenance	Equipment / Items whose maintenance Is required	Points to be inspected	Remarks
1	2	3	4
Half Yearly or when necessary depending upon the condition of service	a) Cleaning  b) Auxillary Fuses c) Wiring & other connections d) Earthing  e) CT's  f) Paint and Danger	1. Make thorough visual inspection of the entire installation 2. Clean off all dust and other deposits with clean and dry cloth 3. Plug all the unwanted gaps / holes to prevent the entry of reptiles & rodents Check and renew, where necessary Examine : Wiring and other connections for being intact  Check leads and tighten connections, if required renew Earthing 1. Examine and clean the bushings 2. Megger test of CTs Paint and repaint the Danger Plate and other details on RMU, if defaced 1. Check for tightness of all Bolts, Nuts & Screws 2. Check trip plunger & reset correctly	Refer Table-II for Grounding Conductor Size / Type

1	2	3	4
<p>Half Yearly or when necessary depending upon the condition of service</p>	<p>h. Circuit Breaker</p> <ol style="list-style-type: none"> <li>1. VL / BOCB               <ol style="list-style-type: none"> <li>a. Oil                   <ol style="list-style-type: none"> <li>1. Top up the Oil, where necessary</li> <li>2. Check if the Oil has become thick or Carbonised. If so replace the oil</li> </ol> </li> <li>b. I.R. Values</li> </ol> </li> <li>c. Contacts</li> </ol> <p><b>2. V.C.B.</b></p> <ol style="list-style-type: none"> <li>a. Operating Mechanism</li> <li>b. Vacuum interrupters</li> <li>c. I.R. Values</li> </ol> <p><b>3. On Load Oil Isolator (O.D.)</b></p> <ol style="list-style-type: none"> <li>a. Oil</li> <li>b. I.R. Values</li> </ol>	<ol style="list-style-type: none"> <li>3. Check and lubricate racking mechanism, truck wheels, racking interlocks and other moving parts</li> </ol> <p>Check operation of tank lowering device and lubricate as necessary</p> <ol style="list-style-type: none"> <li>1. Top up the Oil, where necessary</li> <li>2. Check if the Oil has become thick or Carbonised. If so replace the oil</li> </ol> <p>Check the I.R. Values of Bus-bar and Breaker</p> <p>Check fixed and moving contacts and replace if necessary</p> <p>Lubricate Operating Mechanism with good quality engine oil</p> <p>Check for condition of the V.I.</p> <ol style="list-style-type: none"> <li>1. Check I.R. Values of Both Phase to Earth and between contacts of the V.C.B in open condition</li> <li>2. Check I.R. Values of Bus Phase to Phase and Phase to Earth</li> </ol> <ol style="list-style-type: none"> <li>1. Top up the Oil, where necessary</li> <li>2. Check if the Oil has become thick or Carbonised. If so replace the oil</li> </ol> <ol style="list-style-type: none"> <li>1. Check I.R. Values of O.D. Main Insulators</li> <li>2. Check I.R. Values of Bus Bars.</li> </ol>	<p><b>Conduct I.R. Value test with all the Insulators in good, clean and dry conditions</b></p> <p>The I.R. Values shall not be less than 200 M. Ohm</p> <p>If the I.R. Values are below the limited value, report immediately to concerned MRT for remedial action</p> <p>Refer the Manufacturer's Manual. If any defect is found report the matter to MRT immediately</p>

1	2	3	4
	<p>c. Circuit Breakers Contacts</p> <p>d. Insulators</p> <p>e. Mechanism</p>	<ol style="list-style-type: none"> <li>1. Examine for burning, pitting or other damages to main and arcing contacts</li> <li>2. Clean &amp; grind them with fine sand paper, replace contacts where necessary</li> <li>3. Check for proper contact-wipe and adjust where necessary.</li> <li>4. Check for simultaneous closing and opening of all the contacts</li> </ol> <ol style="list-style-type: none"> <li>1. Clean &amp; examine for signs of damage</li> <li>2. Check &amp; replace where necessary</li> </ol> <ol style="list-style-type: none"> <li>1. Check for tightness of all Bolts, Nuts &amp; Screws</li> <li>2. Check trip plunger &amp; reset correctly</li> <li>3. Check and lubricate racking mechanism, truck wheels, racking interlocks and other moving parts</li> <li>4. Check operation of tank lowering device and lubricate as necessary</li> </ol>	

### **2-B-3 RECOMMENDED SCHEDULES FOR OVERHAULS**

Periodic overhauls are not required for components of 11 KV Line and preventive maintenance at regular intervals is sufficient.

# CHAPTER - 3

## L.T. LINES

### 3.1. RECOMMENDED SCHEDULES FOR INSPECTION

Frequency of Inspection	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
	<p><b>I.</b></p> <ul style="list-style-type: none"> <li>a) Poles</li> <li>b) Stays</li> <li>c) Cross-arms</li> <li>d) Conductors</li> <li>e) Insulators</li> <li>f) Jumpers</li> </ul> <p><b>II.</b> Line</p> <p><b>III.</b> L.T. Feeder Pillar Boxes (FPBs).</p>	<p>Same as recommended for these items in Chapter - 2, Section 2.1</p> <p>Check the following :-</p> <ul style="list-style-type: none"> <li>1) LT Line is Single Phase / 3 Phase 4 Wire / 3 Phase 5 Wire</li> <li>2) Conductor used is 4ACSR / 2ACSR / Rabbit</li> <li>3) Length of the LT Line</li> <li>4) Loose Span</li> </ul> <p>Check the following :-</p> <ul style="list-style-type: none"> <li>1) General Condition of the FPB</li> <li>2) Over Heating of L. T. Leads</li> <li>3) Damage to Lugs</li> <li>4) Connections are tight &amp; intact</li> <li>5) Check the FPB for vermin proof, weather proof and water proof</li> </ul>	<p>Only 4 Pin Cross-Arms to be used for LT Line Extension</p> <p>If any defect is noticed, take appropriate action immediately</p>

### 3.1. RECOMMENDED SCHEDULES FOR PREVENTIVE MAINTENANCE

**Note:-** The steps recommended below are to be carried out in addition to already pointed in-respect of various equipments under inspection programme.

Frequency of Maintenance	Equipment / Items whose maintenance is required	Points to be inspected	Remarks
1	2	3	4
One to Two yearly(depending upon the volume of the work.	<p><b>I.</b></p> <ul style="list-style-type: none"> <li>a) Poles</li> <li>b) Stays</li> <li>c) Cross-arms</li> <li>d) Conductors</li> <li>e) Insulators</li> <li>f) Jumpers</li> </ul> <p><b>II.</b></p> <ul style="list-style-type: none"> <li>a) Line</li> </ul>	<p>Same as recommended for these items in Chapter - 2, Section 2.2</p> <ol style="list-style-type: none"> <li>1. Convert all Single Phase lines into 3 Phase 4 Wire lines</li> <li>2. Replace Conductors of lower capacity by Rabbit Conductors for all Phases and Neutral</li> <li>3. Take action to restrict the length of the line to 500 mtrs</li> <li>4. Provide intermediate poles to all Loose Spans</li> </ol> <p>Cut off the tree branches where necessary to maintain a minimum clearances of 1.8 m on each side of the line</p>	
Every 3 months (Once before the monsoons and secondly after monsoons or earlier if necessary)	<ul style="list-style-type: none"> <li>b) Tree Trimming</li> </ul>		

1	2	3	4
Annually	<b>III. L.T. Feeder Pillar Boxes</b>	<ol style="list-style-type: none"> <li>1. Replace the FPB if deteriorated</li> <li>2. Take action to replace the damaged L.T. Lead with new one of right Capacity</li> <li>3. Replace the damaged Lugs</li> <li>4. Tighten all connections</li> <li>5. Plug all the unwanted gaps / holes to prevent the entry of reptiles and rodents</li> <li>6. Clean all dust and other deposits with clean and dry cloth</li> </ol>	

### 3.3 RECOMMENDED SCHEDULES FOR OVERHAULS

Periodic overhauls are not required for components of L.T. Line and preventive maintenance at regular intervals is sufficient.

# CHAPTER - 4

## SERVICE CONNECTIONS

### 4.1. RECOMMENDED SCHEDULES FOR INSPECTION

Frequency of Inspection	Equipment / Items to be inspected	Points to be inspected	Remarks
1	2	3	4
Two to Three Years (depending upon the volume of the work) OR <b>At the time of Servicing of New Installations or Replacement of Meter in the same Pole.</b> Same as above  Same as above	a) Pole fittings           b) Service Wires & Cables   c) Service Lad in & Meter Board	<p>1) Whether tight and in alignment</p> <p>2) Whether too jumbled up, with numerous services</p> <p>3) Whether Aerial Fuse Boards are provided to all service connections</p> <p>4) Whether pole fuse is readily accessible &amp; in a safe position for replacement</p> <p>5) Whether service wires &amp; pole fuses are distinctly organised so that wires and fuses relating to any service could be distinguished readily</p> <p>Whether all the conductors (Including Neutral) are at a safe distance from each other so as not to strike an arc during high winds</p> <p>Check the following :-</p> <p>a. Meter is in good running condition</p> <p>b. Proper capacity of MCB is installed</p> <p>c. Earthing is as per specifications</p>	<p><b>No New Installations are to be serviced without providing Fibre Glass Aerial Fuse Boards</b></p>

## 4.2. RECOMMENDED SCHEDULES FOR PREVENTIVE MAINTENANCE

**Note:-** The steps recommended below are to be carried out in addition to already pointed in-respect of various equipments under inspection programme.

Frequency of Maintenance	Equipment / Items whose maintenance Is required	Details of maintenance work to be done	Remarks
1	2	3	4
Within One Month after inspection	<ul style="list-style-type: none"> <li>a. Pole fittings.</li> <li>b. Service Wire and Cable</li> <li>c. Service lead in &amp; Meter Board</li> </ul>	<ul style="list-style-type: none"> <li>1. Provide separate Fibre Glass Aerial Fuse Boards for each service connections</li> <li>2. Replace the broken cutouts and renew the fuse</li> <li>3. Readjust the jumpers on the pole, if there is jumbling</li> </ul>	No New Installations are to be serviced without providing Fibre Glass Aerial Fuse Boards
Same as above		Reset for proper clearance from each other	
Same as above		<ul style="list-style-type: none"> <li>1. Replace the Meter by good one if it is faulty</li> <li>2. Take action to replace MCB by adequate capacity</li> <li>3. Arrange for rectification of Earthing if required</li> </ul>	

## 4.3 RECOMMENDED SCHEDULES FOR OVERHAULS

Periodic overhauls are not required for components of L. T. Line and preventive maintenance at regular intervals is sufficient.

# TABLE - I

## DISTRIBUTION TRANSFORMERS

### FUSE PROTECTION AND LT WIRE SIZES

Capacity in KVA	Full load Amps		HT side horn gap fuses in SEG	LT side Protection	Normal section area of cables in sq.mm.
	11 KV	433 V			
63	3.00	84.5	35	LT Protection kit	95
100	5.25	133.5	33		185
250	13.13	333.4	23	MCCB of 20 Nos. for 250 / 300 KVA, 4 Nos. for 500	240 in 2 Runs for 250 / 300 KVA, 4 Runs for 500 KVA
300	15.75	400.5	23		
500	26.26	666.8	20		

**TABLE - II**  
**SIZES OF GROUNDING CONDUCTORS**  
**FOR DISTRIBUTION TRANSFORMERS & RMUS**

Sl. No.	Transformer Rating in KVA	Order of the fault current	Recommended steel conductor type/size
1.	25	200	Guy wire 7/20 i.e., 7 Strands with 8 SWG G. I. Wire
2.	40	320	Guy wire 7/20 i.e., 7 Strands with 8 SWG G. I. Wire
3.	50	400	Guy wire 7/20 i.e., 7 Strands with 8 SWG G. I. Wire
4.	63	500	Guy wire 7/20 i.e., 7 Strands with 8 SWG G. I. Wire
5.	75	600	Guy wire 7 Strands 8 SWG
6.	100	800	Guy wire 7 Strands 8 SWG
7.	200	1600	M.S. Strip 25 mm x 6 mm
8.	250	2000	M.S. Strip 25 mm x 6 mm
9.	400	3200	M.S. Strip 25 mm x 6 mm
10.	500	4000	M.S. Strip 25 mm x 6 mm
11.	R.M.U.		M.S. Strip 25 mm x 6 mm

**BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED**  
**DISTRIBUTION TRANSFORMER INSPECTION REPORT (QUARTERLY)**

ANNEXURE-I

Name of the Sub-Division ..... Page No .....

Name of the O & M Section ..... Date .....

Name of the Sub-Station .....

Name of the Feeder .....

Name of the Transformer Centre/TC Code	
Supports	
Connections	
Fuses(HT & LT)	
Load	
Oil	
Bushings	
Arcing Horns	
Breather	
Barbed Wire, Danger Plate	
LT Distribution Box	
General Condition	
Others	
Remarks	



**BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED**  
**11 KV U.G. SYSTEM INSPECTION REPORT**  
**(QUARTERLY)**

ANNEXURE-III

Name of the Sub-Division ..... Page No .....

Name of the O & M Section ..... Date.....

Name of the Sub-Station .....

Name of the Feeder.....

Name of the RMU .....

RMU No.	
Oil	
OCB Tank	
Auxillary Fuses	
C. B. Closing Mechanism	
11 KV Cable	
Paint and Danger Plate	
General Cleanlines	
Remarks	





# DISTRIBUTION TRANSFORMER HISTORY SHEET

## PARTICULARS

NAME OF THE TRANSFORMER CENTRE.....

Transformer Sl. No.....	KVA .....
Make .....	Voltage Ratio .....
Purchase Order No. & Date .....	% Z .....
Installed at .....	Weight (Gross) ..... K.G.
Installed on .....	Weight of Oil ..... K.G.
Warranty period expires on .....	

## TEST RESULTS

Date of Test	LOAD			Oil	Insulation Resistance		
	R	Y	B		Y <sub>P</sub> to E	Y <sub>S</sub> to E	Y <sub>P</sub> to Y <sub>S</sub>

## DETAILS OF MOVEMENT

Shifted from (Date)	Received for Removal	Received at (Date)	Remarks



# 11KV RMU HISTORY SHEET

## PARTICULARS

NAME OF THE RMU .....

Sl. No. ....	C. Ts. ....
Make .....	Make .....
Purchase Order No. & Date .....	Purchase Order No. & Date .....
Installed at .....	
Installed on .....	
Warranty period expires on .....	

### **TEST RESULTS**

Date of Test	Oil	Relay System	Tripping Mechanism

Shifted from (Date)	Received for Removal	Received at (Date)	Remarks



**MONTHLY REQUIREMENT OF CONSUMABLE MATERIALS**

**FOR EACH O & M UNIT**

1. Cotton Waste
2. Insulation Tape
3. Grease
4. Petroleum Jelly
5. Torch Cells
6. Dettol
7. Copper Terminals 240 Sq. mm/95 Sq. mm -25 Nos. each
8. Cloth Emery
9. Hack Saw Blades
10. P. G. Clamps
11. RMU Fuses.
12. Fuses (5, 10, 15, 20, 30 Amps Ratings)  
100 Amps LT Fuse  
are not provided for T.C's.) -1 Roll each  
-1 Roll (for Rural Areas where LT Distribution Boxes

LIST OF MINIMUM T & P REQUIRED IN EACH O & M UNIT FOR MAINTENANCE OF DISTRIBUTION SYSTEM

1. Rubber Hand Gloves (15 KV Tested)	- 5 Pairs.	22. Mumpteets	-3 Nos.
2. Safety Belts	- 10 Pairs.	23. Morter Pans	-3 Nos.
3. Rain Coats with Caps	- 6 Pairs.	24. G. I. Buckets	-3 Nos.
4. Hand Torches (3 celled)	- 3 Nos.	25. Empty Barrel	-1 No.
5. Hickery Rods	- 2 Nos.	26. Manual Crimping Tool	-1 No. (25 Sq.mm to 400 Sq. mm)
6. Grounding Rods	- 4 Sets (3 rods/Set).	27. Hand Pump	- 1 No.
7. Bamboo Ladders	- 2 Nos.	28. Helmets	-1 for each Line Man
8. Tong Tester (0 to 1000V)	- 1 No.	29. Miscellaneous items like First Aid Box, Shock Charts, Water Filter, Crimping Tool, Fixograph(Big).	
9. Nylon Ropes	- 25 Kgs.		
10. Megger 2.5 KV/5 KV Megger 500 V	- 1 No. - 1 No.		
11. Screw Driver of Sizes 6" to 18"			
12. D. E. Spanners			
13. Screw Spanners	- 1 Set in Tool Kit and Bag for each Line Man.		
14. Box Spanners			
15. Adjustable Winch Spanner			
16. Insulated Cutting Pliers			
17. Hammer 2 lbs. & 8 lbs.	- 1 No.		
18. Hack Saw Frames	- 2 Nos.		
19. Bolt Cutter	- 1 No.		
20. Chain Pulley Block (2 Tonnes)	- 1 No.		
21. Crow Bars	- 3 Nos.		

## **BIBLIOGRAPHY**

- ✓ “Maintenance Schedule for Distribution System”, Technical Report - 2 (July 1974), Research Scheme on Power, Central Board of Irrigation and Power, New Delhi.
- ✓ KPTCL Maintenance Schedule for distribution system.