

PART 2: EMPLOYER'S REQUIREMENTS

**CHAPTER 14: DLP/AMC OF OHE, PSI
AND SCADA**

TABLE OF CONTENTS

1.	SCOPE OF WORK FOR DLP/AMC OF OHE.....	3
1.1.	DUTIES OF SENIOR ENGINEER / OHE.....	3
1.2.	DUTIES OF FIELD ENGINEER	5
1.3.	DUTIES OF WORKING STAFF (SKILLED /UNSKILLED).....	6
2.	MAINTENANCE PROGRAMME	7
2.1.	PREVENTIVE MAINTENANCE.....	7
2.2.	CORRECTIVE MAINTENANCE.....	15
	SCOPE OF WORK FOR DLP/AMC OF PSI & SCADA	25
3.	DUTIES AND RESPONSIBILITIES OF SR. ENGINEER (PSI)	25
3.1.	DUTIES AND RESPONSIBILITIES OF FIELD ENGINEER.....	27
3.2.	DUTIES OF WORKING STAFF (SKILLED)	28
3.3.		
4.	MAINTENANCE PROGRAMME	30
4.1.	PREVENTIVE MAINTENANCE.....	36
4.1.1.	DETAILED CHECK SHEETS FOR MAINTENANCE OF PSI INSTALLATIONS	
	37	
4.1.2.	MAINTENANCE SCHEDULE OF SCADA SYSTEM.....	49
4.2.	CORRECTIVE MAINTENANCE.....	50

1. SCOPE OF WORK FOR DLP/AMC OF OHE

During Defect Liability Period /Annual Maintenance contract, Contractor shall depute dedicated manpower round the clock in shifts prescribed in Table 1 at designated place as agreed by employer for attending breakdowns and preventive maintenance activities.

This shall be read in conjunction with Sub clause 10 of SCC applicable for DLP and AMC as well. This excludes the responsibility of the contractor during DLP defined in Tender Documents.

S. No.	Staff Designation	No. of persons to be deployed	Min. Qualification
1	Sr. Engineer	1	Degree with 5 yrs. Experience of similar nature
2	Field Engineer	1 per shift	Degree with 3 years similar Exp./ Diploma with 5 years similar Exp.
3	Skilled	3 per shift	ITI with 3yrs. Similar Exp.
4	Un-skilled	2 per shift	-

Table 1 Manpower

Contractor shall set-up OHE Depot, corresponding stores, repair shops, which includes furniture, material racks staff cup-boards, tools instruments, material handling instruments, communication instruments, material consumable etc. in addition to proper upkeep of all the installations and vehicles in OHE.

Manpower mentioned above shall be able to perform duties as follows:

1.1. Duties of Senior Engineer / OHE

He/She shall be in-charge of Contractor's OHE maintenance team responsible for Safe, efficient maintenance of OHE installation at depot and mainline. He/she should be fully conversant with the layout and sectioning of OHE and the rules and procedures laid down for efficient maintenance of OHE and safe working on OHE.

In particular he/she shall:

1. Supervise the preventive and corrective maintenance of installations under his charge in accordance with the standard and prescribed schedules, to keep them fully serviceable all times and in a state of good repair. To ensure proper record of preventive and corrective maintenance of all installation in his control and submit monthly report to employer with completion and next due dates (Equipment wise):
2. Ensure advance planning of Preventive maintenance with a view to avoid OHE failures and requirement of power blocks for OHE maintenance based on the work done in consultation with the OCM through CTPC and ensure completion of work within the time allotted.
3. Carry out detailed inspections of OHE under his control by CMV to cover the entire section once in two months and submit the inspection report to Employer without fail. To carry out all necessary inspections of his assets as per the statutory requirement or otherwise and shall notify and rectify any defects / deficiencies found during such inspections.
4. Scrutinize daily reports and other defects on OHE, as well as reports from TPC inspections

- reports of Employer and arrange prompt rectification of defects pointed out and report compliance to Employer and ensure their implementation.
5. Instruct train and supervise staff under his control and ensure that they shall operate and maintain the equipment properly and do actually observe all prescribed rules and regulations, Joint Procedure orders issue time to time safety precautions, SHE policy laid down for this to ensure proper training of all the staffs working under him, ensure Personnel Protective Equipment (PPE) while working on the system for self and working staff as well.
 6. Ensure that special testing instruments tool and equipment including the OHE inspection cars (provided and maintained by others) and breakdown vehicles, for maintenance of OHE are properly cared for and maintained in proper condition.
 7. Ensure that special tools and instruments provided for maintenance and testing of all installations are carried for corrective and preventive maintenance, their timely calibration, storing at proper place etc. He shall ensure that other safety equipment including bonding and earthing are functioning effectively.
 8. Keep employer fully informed of all-important development and seek their guidance when required.
 9. Ensure proper upkeep of drawing, manuals and other all relevant literature as per laid-down conditions of contract agreement.
 10. Check the work done by maintenance gangs under him to ensure the quality work and that compliance with prescribed schedules is adhered to.
 11. To ensure submission of prescribed periodical returns after scrutiny and remedial measures suggested to avoid recurring failures and submit
 - i. Failure analysis reports.
 - ii. Unusual occurrence reports.
 - iii. Power block and PTW reports.
 - iv. Accidental reports.
 - v. Staff position reports to employer and compliance of the instructions issued if any based on such returns.
 12. To ensure proper competency with their validity of the staff working under him and arranging training for issue of competency and depute staff for refresher course.
 13. Ensure making of each equipment's history, technical details updated and submit as and when required by the employer promptly.
 14. Ensure display of details of inspection schedules and the limit / tolerance and kept ready at site.
 15. Keep the maintenance team, for attending to breakdowns, in constant readiness to act promptly and expedite restoration whenever there is a breakdown. To attend any emergency / breakdown wherever and wherever required in a minimum possible time.
 16. To follow all statutory regulations in force from time to time.
 17. Carry out any other duty assigned to him by employer related to work.

1.2. Duties of Field Engineer

The field Engineer of OHE will be under the Sr. Engineer/OHE and each Field Engineer will be responsible for the following.

1. Maintenance of the OHE and allied installations in his jurisdiction in accordance with the prescribed schedules with a view to avoid failures.
2. Submission of the requirements of power blocks / Track access for OHE maintenance, in Co-ordination with P-way maintenance and other departments concern as far as possible, to take

- maximum advantage of Non-traffic hours.
3. Detailed inspection of OHE under his charge by CMV or on foot as indicated in inspection schedule.
 4. Scrutiny of daily foot patrol reports, daily reports of defects and take prompt action to rectify the defects brought out.
 5. Close supervision of the maintenance gang under his control to ensure a high standard of work and compliance with prescribed schedules. Also convey each and every preventive and corrective maintenance progress himself to CTPC/TPC as well as it should be written in the progress register.
 6. Keeping the team under his control in readiness to deal with breakdowns and take prompt action to attend any failure and breakdowns following all safety rules and regulations.
 7. Guidance to the maintenance staff for the proper execution of work in accordance with standing instructions.
 8. Ensuring that tools and equipment's under his charge are properly cared for and maintained in proper condition.
 9. Keeping watch and taking necessary and timely action to recoup spares required for the system.
 10. Preparation and submission of periodical reports and returns to Sr. Engr.
 11. Keeping Employer informed of all important developments and seeking their guidance when required.
 12. Ensuring proper cleaning of each equipment.
 13. Keeping proper records of all reference drawing, manuals, maintenance schedule etc. for proper operation and maintenance of equipment's.
 14. Ensuring safe working by maintenance personnel at site while doing of maintenance of equipment's.
 15. Ensuring proper competency of the maintenance personnel before commencement of maintenance activity.
 16. Ensuring periodical checking / inspections of all testing tools, safety equipment's and measuring equipment's etc. timely and their rectification of deficiencies / defects notices if any and maintaining their proper records.
 17. Carry out any other duty assigned to him by employer related to work.

1.3. Duties of Working staff (Skilled /Unskilled)

1. All Staff should have requisite competency to enable them working independently.
2. Every staff should be conversant with the safety rules pertaining to his work and be capable of independently attending to minor repair and adjustment work on OHE. For this purpose, he is required to always carry his tool box, communication equipment, other equipment's as required for cleaning, measuring, lighting, safety equipment's (such as discharge Rods), ladder etc with him.
3. Skilled staff should look for the common types of defects on OHE when they are deputed for patrolling duty and report defects noticed during such patrolling to the supervisors.
4. Every skilled staff should be able to carry out temporary repair in the event of breakdowns to restore traffic as quickly as possible and to deal with repairs necessary for all types of breakdowns of OHE.
5. Make general check of all earth connections.
6. Staff shall carry out the cleaning, oiling, bolting, servicing, minor adjustments and repairs, daily checks and other works as part of corrective and preventive maintenance.
7. Carry out any other duty assigned to him.

2. MAINTENANCE PROGRAMME

Contractor shall develop and submit maintenance program to achieve high reliability and ZERO- DEFECT OHE, and to ensure effective execution of the maintenance work for the approval of Employer. Document shall be based on the manufacturer recommendation and previous experience of the equipment installed in other railways/metros, O&M manuals, 25kV ACTM in force, General Rules for Metros, Safety Rules, Applicable Standards etc. Document shall include the but not limited to

1. Organization Chart for AMC
2. Maintenance activity
3. Periodicity
4. Detailed Procedures
5. Checklists/ Registers/ Reports Formats
6. List of Equipment's (T&P) to be used for maintenance including measurement instruments.
7. Precautions
8. Any other formats
9. Responsibilities.

Contractor shall provide & maintain an emergency road vehicle (with driver) in good working condition all the time and keep all spares and T&P in accordance to the List as per Table 2. In case Emergency Road Vehicle is under maintenance standby arrangements are to be made by contractor. Emergency Road vehicle shall be equivalent to TATA 1109 or higher capacity so that it can carry all T&P and spares including 6/7 mtrs. long Aluminium Ladders and with sufficient seating capacity for maintenance gang.

Contractor shall also ensure that CMV is maintained in good working condition all the time and to ensure that keep all spares and T&P in accordance to the List as per Table 2. Maintenance of CMV is to be done by designated contractor.

Contractor shall also maintain records for maintenance of Emergency vehicle and CMV. However minimum guidelines for the same are as follows.

Maintenance activities are broadly categorized as Follows:

- A. Preventive Maintenance
- B. Corrective Maintenance

2.1. Preventive Maintenance:

OHE is subject to dynamic oscillations due to the constant contact and movement of the fast moving pantograph coupled with wind pressure. It is necessary to maintain the OHE in perfect condition through proper checks on its geometry and all parameters adopted in the design.

Following activities are to be carried out during preventive maintenance:

- i) Foot Patrolling:

Foot patrolling of complete section and depot is to be done as per prescribed format as per schedule below.

S. No.	Done by	Viaduct	At grade
1.	Skilled staff associated by unskilled	Monthly	Weekly
2.	Field Engineer	Quarterly	Monthly

Checklist for Foot patrolling is enclosed as Annexure-FP.

ii) Current collection Tests:

It is necessary to carry out periodic tests to detect points at which contact between the contact wire and pantograph is unsatisfactory resulting in sparking. Such current collection tests are performed at night.

A video camera shall be fixed on the roof of the train selected for current collection test, so that it can capture the complete view of pantograph interaction with OHE. A display screen connected to camera, able to show real time view, may be installed in saloon of the train to observe the sparking. Above arrangement for current collection shall be done by RS wing. During current collection test (in nonrevenue hours) one OHE staff shall be deputed in driving cab to announce the approaching location by using PA system of the train. The location where the sparking is observed, and the severity of the sparking should be immediately noted down by the OHE engineer jointly with RS staff. A report of such locations shall be prepared of complete section in prescribed format and the OHE at the sparking location got checked up as soon as possible to find out and eliminate the cause of sparking. Compliance report for attending the sparking location recorded during current collection test shall be submitted to the employer in due course of time.

The current collection tests as above should be carried out by the maintenance in charge once in 6 months over his entire section. Employer representative may also accompany during such tests, so information should be given in advance.

iii) Special checks:

While most items require attention only during Periodical Maintenance and Periodical Overhaul, items listed below will require more frequent attention as indicated against each:

1. **Insulators:** Generally, insulators need cleaning along with the maintenance schedule. At locations subject to smoke pollution or pollution due to industrial dust, the frequency of cleaning will have to be fixed based on the extent of such pollution. Where pollution is heavy, cleaning may have to be done more frequently. Polluted zones of complete section are to be identified by in charge in consultation with Employer and cleaning of insulators is to be done before monsoon and winter season. All Section Insulator and Short Neutral Section (PTFE) should also be checked more frequently as per OEM instructions and pollution level.
2. **Bi-metallic clamps:** The condition of junctions shall be checked by Thermal imaging camera to be provided by OHE contractor. The hot spot hence noticed shall be immediately attended in next available power block. Bi metallic strip wherever provided shall be replaced with new one. Yearly checking of condition of bimetallic strip provided in Switchgears of Switching post shall be carried out. All the worn-out strips shall be replaced.
3. **Earth Connections:** Apart from general inspection of bond and earthing connections during foot-patrolling, all such connections should be specially checked for continuity and soundness of connections once in a year. Particulars of all earthing connections should be entered in a Register station-wise for each section and the dates of Yearly inspection entered therein.
4. **Feeders:** Foot-patrolling of 25 kV feeders should be carried out every month. During this check, the Maintainers shall also check that safety guards provided under the feeders properly earthed, if the clearances are adequate and caution notice boards are in position.
5. OHE supported on steel girder bridges should be examined as frequently as possible depending upon traffic conditions.
6. **Bird nests:** Vigil should be exercised especially during the nesting season and the nests removed

as soon as possible.

7. **Pre-monsoon checks:** Some of the items to be attended to are -

- All pulley type ATD's shall be checked for their free movement & X-Y values adjusted if required.
- All tree branches in the section shall be trimmed to avoid any untoward incident.
- Earth continuity and earth resistance shall be checked for all equipment installed in section and recorded as per IE rules, rectification action shall be taken as required.
- Special check shall be carried out to ensure working of isolators, BM, LA.
- Where there is dripping of water on OHE/OCS from overline structure on earlier occasion shall be regularly monitored. If found, same should immediately informed to civil/works department.
- Mast is to be checked for any leaning at grade section.
- PVC sleeve on BEC wire under track circuited rail to be checked for its healthiness to avoid signal failures due to short circuiting.
- MVLC sleeves on catenary wire.
- Any special instruction issued time to time shall also be complied.

iv) Routine Maintenance:

This schedule shall be carried out by CMV preferably during power block. During the schedule, fittings are not generally dismantled, but all fittings, which are found defective, must be replaced. In addition, clearances, heights, staggers etc. should be checked and corrected.

The details of work to be carried out during this schedule are as under-

- a) Masts, portals and cantilever supports and conductors (Periodicity :24 months on Viaduct locations and 12 months on Grade Locations)
- Check rail level and setting distance against markings on the masts and entries in the Register. Variation above 30 mm in setting distance and 20 mm in rail level should be notified to the P-Way for correction. Variations, even within the above limits, should not be permitted if the Schedule of Dimensions is infringed.
 - Check all steel parts and remove rust, if any, from painted steel work. Rusted portions, after cleaning, must be given two coats of zinc chromate primer followed by aluminium paint.
 - Check all anchors for tightness of bolts, nuts, and check nuts and pins, Lubricate all turn buckles/adjusters and pulleys.
 - Nut Bolt of mast base plate at viaduct to be checked and tightened. If required. Also check the availability of GP2. At grade examine the base of each structure to ensure that muffs permit drainage of water. Clean the muffs removing any muck or dirt. Cracked or damaged muffs must be recast.
 - Check all bonds/BEC/OPC connections thoroughly. Defective bonds must be rectified, and missing bonds provided.
 - Check and tighten all bolts and nuts. Marking with paint/marker pen is to be done to avoid un-necessary tightening.
 - Check all galvanized pipes and fittings. Where galvanization is found to be chipped off, the fitting of pipe should be replaced. Minor chippings may be repaired using 'cold galvanizing paint'.
 - Examine register arm and all hooks and fittings for cracks. Condition of steady arm for any damage to crimped portion (if applicable) must be checked especially at rigid dropper location.

- ST, BT, & 9 Tonne anchor composite insulators must be cleaned with soft and clean cloth and check Insulators for flash mark. Apply Insulating spray paint at any flash mark on Insulators. Clean all porcelain insulators (if applicable) and carefully check for cracks and broken sheds. If more than 2 sheds are broken or there is any crack on the core the insulator should be replaced.
- Note down the CW height & stagger and adjust if required as per SED's.
- Check presence and condition of caution notice boards, number plates, coasting boards, etc. Paint Replace the boards as required. Ensure that they are all well secured.
- Ensure that the drain holes in the tubes are free and not clogged.
- As the bracket is articulated, check the position with reference to the axis of the mast. The position will vary with temperature and distance from anti-creep. The register arm and steady arm should as far as possible be in the same plane as the bracket.
- Check for either spring washer or locknut on bolt. Mouth of all split pin should be opened fully.
- Check for any broken strands of jumpers, dropper, specially inside/near the clamps/connectors.
- Check for proper tightening of nut bolts of caution board & number plate.
- Contact and Messenger Wires: Check carefully condition of contact and messenger wires, particularly for kinks and twists in contact wire and broken strands of messenger wire. Any stranded conductor (Messenger wire etc.) should be spliced if more than 20 per cent of the strands are broken. In case of less than 20% strands are broken, it may be secured by dropper clip.
- Droppers:
 - Droppers should be vertical and tight. Replace if found loose with appropriate dropper.
 - Check droppers for any damage or rubbing at multi cantilever location, correct if required.

b) Turn outs (Periodicity: 12 months)

The point at which one track separates/meets with another track is called turnout. From OHE point of view turnouts are provided for smooth transition of pantograph during movement of train from main line to branch line or vice-versa.

1. With OHE Inspection Car running on main line check-up if pantograph glides smoothly under the loop line OHE without any contact.
2. While moving on main line to branch line (Turnout) or vice versa smooth transition of pantograph from main line to turnout wire at appropriate take-off must occur. Take-off/Take-on of main line wire should be at a stagger of 55 cm.
3. Check stagger of both the OHEs at turn outs. (It shall not normally exceed 300 mm).
4. Check that the main line OHE of overlap type turn out is about 50 mm below that of the turnout OHE.
5. Check the sag of Section insulator at turnouts/crossovers should be zero. Also check the stagger.
6. Check-up cross contact bar, cross droppers, if any, for displacement and distortion. Check up for hit marks, if any.
7. Check-up rail level, track separation, contact wire(s) separation/gap and setting of the obligatory mast.
8. Check up for hard spots near rigid droppers, if any.

c) Section Insulators:

(Periodicity: Monthly for polluted zone locations and Quarterly for others on Main Line)

Section insulators on the main lines and yards/depot should be attended to as under once in three months:

1. Clean Core insulators with soapy water, rinse thoroughly with potable water. Use dry and fluff less cloth. Replace Section Insulator if badly chipped or even slightly cracked.
2. Check runners for flash-marks. Carbon deposition on is to be cleaned by carbon cleaner.
3. Check level of the assembly and adjust as required. Longitudinal and transversal parallelism with regards to running plane should be checked and corrected if necessary.
4. Diameter of contact wire at both ends of SI is to be measured and recorded. Check for excessive contact wire wear near anchor clamps.
5. All nuts, bolts, check nuts and split pins of runners and dropper is to be checked and tightened properly if required.
6. Smooth gliding of pantograph underneath SI is to be checked and any hitting or problem in smooth transition is to be adjusted by adjustable droppers.
7. Check all other requirements as proposed by OEM.

Note: Section Insulator installed at depot to mainline interface and in polluted zone must be cleaned with Soapy water on monthly basis or as directed by Engineer In-Charge.

Section Insulators: Section insulators (Tramway) in the yards/depot should be attended to as under once in Six months –

- Clean insulators and replace badly chipped or even slightly cracked insulators.
- Check runners for flash-marks.
- Check level of the assembly and adjust as required.
- Check for excessive contact wire wear near anchor clamps.
- Measure and record min. electrical clearance between runners and core insulator. Correct if less than specified.
- Check that pantograph passes underneath the SI smoothly.

d) Isolators: (Periodicity: 12 months)

- Check number plates for cleanliness and security.
- Check correctness of operation, alignment of contacts and arcing horns. Check earth continuity where applicable.
- Lubricate moving parts and locks.
- Check interlocks where provided.
- Check that the distance between male and female contacts and electrical clearance in open position and adjust them as specified.

e) Overlap (IOL/UIOL)

(Periodicity: 24 months on Via duct locations and 12 months on Grade Locations)

Where two OHE's wire lengths are overlapped to each other with adequate horizontal separation (500 mm for IOL & 200 mm for UIOL) and suitable stagger is known as overlap. The overlap is so arranged that both OHE's are available to the pantograph for min. 2 mtr at the same level on either direction of central mast. Thereafter the OHE's are raised gradually by 500 mm and held at intermediate mast by RRA Clamp.

- Check height and stagger of OHE in the overlap section.
- Check whether the normal minimum clearance of 500 mm is available between the two OHEs in an insulated overlap and 200 mm in an un-insulated overlap.
- Check whether the lifting of out of run OHE is correct.
- Check that parallel running of contact wires in the overlap for a minimum 2m in the panto sweep region.
- Check jumpers for any damage or signs of heating at jumper fittings / PG clamps. Check the tightness of RRA clamp and jumper fittings.

f) Contact Wire thickness: (Periodicity: 12 months)

Measure and record thickness of contact wire at 2 locn. of Platform where the train starts and mid location of every kilometre near swivel clip.

Marking is also to be done at the same locations for future reference.

g) Neutral Sections:

Neutral Section shall be checked by in-charge on monthly basis as per list below:

Neutral Section (SNS Type)

Short Neutral Section

- Check runner for any Flash mark or Hitting. If hitting marks observed on runner, readjustment of neutral section is to be done with the help of Jig. If runners are badly worn out, then replace it.
- Check condition of arcing horn.
- Check PTFE rod for any flash mark. Clean with normal water. Detergent is to be used if found dirty.
- Measure the PTFE rod wear, turn it if more than 13 mm. Replace it if already turned four times.
- Check the droppers for tightness.
- Check the condition of adjuster, earthing jumper, splices, lock nut pins etc.
- Check the hogging, if found improper then adjust it.
- Check all other requirements as proposed by OEM.

h) Regulating Equipment: (Periodicity: 12 months)

Pulley Type: Inspect the good condition of the tensioning device assembly with a special interest on the following points:

- Check the position of the stainless-steel cable in the anchor clamp, compensating plate and measure X, Y parameters.
- Check the good condition of the stainless-steel cable: for any damage, wear or broken strand. Change the cable if necessary.
- Check the alignment of the pulleys and free movement of counter weight. Any rubbing of SS cable should be attended immediately.
- Check the tightening of the Nuts & bolts and the open V pins, and the condition of the pulleys.
- Grease the ball bearings with the grease pump on the axles end. Use only the SKF (LGE P2) or equivalent grease. Put the grease until the new grease coming out the side of the

ball bearing.

- Preferably use a manual grease pump.

Spring Type ATD:

Maintenance of Spring ATD shall be done as per recommendation of manufacturer (OEM) and previous experience of the equipment installed in other railways/metros, O&M manuals, 25kV ACTM in force.

i) Bonds & Earthing Connection.
n depots/yards

- Check all bonds and replace defective or missing bonds. Paint all bonds. (During Foot patrolling)
- Inspect earths (Earth Pits) and record earth resistance. Earths (Earth Pits) having resistance of over 10 ohms should be attended to. (Annually)

In main line

- Check all connections and condition of BEC, plinth jumpers. (During Foot patrolling)
- All ITL/ Impedance bonds connections with RG, OPC, BEC and rails are to be checked for their healthiness. Check for any sign of heating, attend if required. (Annually).

Sites affected by accidents:

Such sites should be specially checked and attended to during routine check-ups also.

Feeder Lines:

- Check earthing of towers.
- Measure and record earthing resistance of towers.
- Clean insulators and replace those, which are cracked or chipped.

v) Periodical Overhauls
(Periodicity – 4.5 years)

The bottom line of carrying out any scheduled maintenance is that once it is carried out that equipment should not fail till the next schedule falls due. The aim of POH is to recondition and restore the installation in the condition it was when it was first commissioned, whereas preventive maintenance has for its objective to take care of the wear and tear during normal service and forestalling possible failures by regular inspection and prompt attention.

The work involved during POH is somewhat greater in scope than the pre-commissioning tests, since after years of service many parts would have suffered wear and tear, of which necessary adjustments will have to be made or repairs done to make good the wear, or the irreparable items replaced.

The POH of OHE should be planned on a programmed basis as per the schedules laid down. For programming POH, the entire section should be divided into smaller sections in accordance to identified polluted zones.

- a) Cantilever: One complete cantilever in Identified polluted zone is to be replaced and its thorough cleaning and detailed examination of its moving parts for free movement is to be done. Check complete cantilever component for cracks, rust and thread damage with a

magnifying glass. The crack fittings and damage threads fittings should be discarded. Deteriorated GI fittings and pipes should be repaired by using cold galvanized paint. If any major defect is found another cantilever from the same section shall be examined for the same. Remedial action to be initiated if the problem persists in consultation with employer.

- b) Regulating Equipment (Pulley Type ATD): All regulating equipment (ATD) should be replaced with the overhauled ATD. SS rope should be closely examined for any damage to its strands. Ends of SS rope is also to be reversed. X & Y values to be adjusted as per temperature chart either by wire cutting or by adjuster. Removed ATD is to be taken to workshop for cleaning and check for any rubbing mark on pulley block, if any replace the same. All lubricating holes should be free for passage of grease. Check for free movement of bearing of pulley block. Grease should be applied in the bearing by grease gun. Damaged part is to be replaced with new one.
- c) Jumpers, Messenger and contact Wire: POH of all jumpers i.e. Continuity, Anti-Theft, Equip-potential, feeder jumpers etc. to be done. Dismantle all jumper connections. Clean the conductors by emery paper, if there is a sign of overheating. Remove kink if noticed. Check for broken/damage strands. Overheating or corrosion especially at PG clamps & BM flange connection.

2.2. Corrective Maintenance

Bottom line of carrying out preventive maintenance is that once it is carried out that equipment should not fail till the next schedule falls due. Generally, it shall be carried out during non-traffic hours on main line. Despite of above intense maintenance schedules and different proven power supply arrangements installed following failures are observed in OHE. These failures are to be attended during revenue hours after taking power and traffic block of affected section.

1. Catenary strand break/parting is predominating failure in OHE
 - Remedial action: Above breakdown must be immediately attended after taking Power and traffic block on main line by temporary restoration i.e. taking load by tirfor. Same is attended by catenary splicing in night power block (during non-revenue hours).
 - Approx. Time for temporary restoration: 6-10 minutes in case of strand broken and 25-30 minutes in case of parting
2. Failure of ST/BT insulator.
 - Remedial action: Above breakdown should immediately be attended after taking Power and traffic block on main line by replacing the faulty insulator with new one.
 - Approx. Time for restoration: 15-20 minutes in each case i.e. replacement of ST or BT insulator.
3. Contact wire parting
 - Remedial action: Above breakdown must be immediately being attended after taking Power and traffic block on main line by splicing contact wire.
 - Approx. Time for temporary restoration: Approx. two hours in case of parting since It requires highly skilled and trained artisans as smooth panto run is to be maintained on spliced contact wire.
4. Section Insulator burnt and parted
 - Remedial action: Above breakdown is a major breakdown and shall be attended as

per site conditions immediately.

- Approx. Time for temporary restoration: 2-3 hours in case of replacement of SI since It requires highly skilled and trained artisans and precision work to replace SI and smooth panto run is to be maintained by levelling of SI by droppers. As in case, multi activity may be required/involved such as splicing of Contact wire in place of SI and replacement of nine tonne insulator etc.

5. Breakage of span dropper

- Remedial action: Above breakdown should be attended after assessment of situation as if only one dropper is broken, Same is to be attended by replacing in night block (non-revenue hours). If the damage is more or in overlap spans same should be attended immediately to avoid pantograph entanglement.
- Approx. Time for restoration: 6-10 minutes for each dropper.

For attending above breakdowns Contractor's OHE team should be ready at designated place all the time and immediately move to the place of breakdown/incident by Emergency Road vehicle generally.

For the movement of Emergency Road vehicle all necessary permissions e.g. Road permit, movement in no entry area, RC, PUC etc from local authorities are to be taken by the by the contractor and be valid all the time.

Only in case of major breakdowns, if required, CMV can be moved after taking due permissions from traffic controller to the breakdown site in consultation with employer official.

In addition to above, any other breakdown during revenue hours may occur due to any reason which is also to be attended by contractor's OHE team and train services are to be restored at the earliest.

Unusual Occurrence report should also be submitted within 3 days to the employer in prescribed format.

OHE EMERGNECY MATERIAL (T&P) TO BE KEPT IN CMV & EMERGENCY ROAD VEHICLE.

Sr. No	Item Spares	Unit	Qty
1	Complete cantilever assembly	No	30
2	Steady Arm Bend Type for main line	No	30
3	Special Type Steady Arm for IOL	No	30
4	ST, BT, RT cap	Set	318
5	Automatic Tensioning Device assembly of 5-Pulley Block Type including all fittings, Weight and ATD Cage	No	6
6	Section insulator with accessories (in box)	No	6
7	Inclined dropper	No	66
8	J - Bolt	No	105
9	Span Dropper Wire (Electrolytic hard drawn Cu)	KM	0.30
10	Span dropper assembly of various sizes	No	210
11	Catenary Wire - 120 sq. mm (Cu-Mg)	KM	.36
12	OPC wire	KM	1.5
13	RC Wire	KM	1.5
14	Contact Wire -150 sq. mm (Copper Silver)	KM	1.5
15	I - sec Steady Arm (High speed)	No	18
16	Bracket Tube fitting	No	18
17	Stay Tube fitting	No	18
18	V Bolt of Guy Rod	No	18
19	Special PG of Section Insulator	No	51

Sr. No	Item Spares	Unit	Qty
1	Tirfor 5.0 Tonne/ 3.0 Tonne with 20m steel rope	Set	3
2	Pull - lift 3/4 Tonne (with loop type chain)	No	4
3	Come along clamps for catenary suitable for 19/2.108 mm conductor (65)	Set	2
4	Come along clamps for contact wire 107 mm ²	Set	2
5	Come along clamps for contact wire 150 mm ²	Set	2
6	Come along clamps for catenary wire 120 mm ²	Set	2
7	Come along clamps for ACSR conductor 93.3 sq. mm	Set	2
8	Come along clamps for ACSR conductor 233.3 sqmm	Set	2
9	Earth Discharge rod complete (light weight 11 kgs (As per RDSO spec. ETI/OHE/51(9/87) Re. 1, Oct 92 H-6 to be supplied)	Set	10
10	Aluminium Straight ladder (8m) with Hook on top	No	4
11	Aluminium Straight ladder extensible (11m)	No	4
12	Drilling machine (25mm) Motor Driven (radial or pillar)	No	1
13	Bench Grinder (Double end) pedestal motor Driven (203 mm) disc	No	1
14	1Ph portable welding machine only required	No	1
15	Portable Diesel Generating set 3 KVA 240 V, 1Ph	No	1
16	Contact wire Cutter 36 inch	No	2

17	Dropper wire Cutting 12 inch	No	2
18	Single Sleeve pully block 3 1/2" x 1/2" Groove steel	No	10
19	Single Sleeve pully block 3 1/2" x 1/2" Groove steel fiber for drawl of contact catenary wire	No	15
20	Single Sleeve pully block 6" x 1" Groove steel (with top eye to be supplied, cap 2T, asper IS: 13156 of H-18 1991	No	6
21	Contact wire twist cum bender 6 inch	No	4
22	Steel sling with eye end 19mm dia (a) 1 m Long	No	10
23	Steel sling with eye end 19mm dia (a) 2 m Long	No	10
24	Steel sling with eye end 19mm dia (a) 3 m Long	No	8
25	Steel sling with eye end 19mm dia (a) 4 m Long	No	5
26	Steel sling with eye end 19mm dia (e) 10 m Long	No	5
27	Contact wire Splicing jig	No	1
28	Copper Hammer 2 kg	No	1
29	Metric tape 30 m, 15m each (PVC tape only)	No	5
30	Light weight ladder trolley	No	1
31	Engineering Ratchet	No	2
32	LED Tri colour lamps	No	2
33	Trifor 3 Tonner/2 Tonne	No	5
34	Spring balance 25 kg capacity	No	1
35	Wire claws (Panja)	No	2
36	Crowbar	No	1
37	Shovels	No	1
38	Sledgehammer 10 lb	No	1
39	Tree pruner (with telescopic handle & saw blade)	No	1
40	3/4-inch Manila rope 100m	No	1
41	1/2-inch Manila rope 150m	No	1
42	1 inch Manila rope 50m long	No	1
43	Manual rail hole drilling Ratchet and clamp with chamfering tool	Set	1
44	Dynamometer 10-Tonne capacity with carrying box with 150 mm Dia with test certificate	No	1
45	High focus LED rechargeable hand torch light.	No	5
46	Walkie Talkie sets (with 2 km range working on 'c' band)	No	4
47	Megger 2500V	No	2
48	Digital earth clamp megger to be supplied	No	1
49	Light weight Toolbox	No	3
50	Set of tools for Technicians a) DE Spanner set from 6 TO 32 (12 PIECES)	No	5
51	Ring Spanner set 16x17, 18x19, 20x22, 24x26, 30x32, 36x40	No	5
52	Screwdriver 6 "	No	5
53	Screwdriver 12 "	No	5
54	Hammer 1/2 lb	No	5
55	Cutting plier	No	5
56	Plumb bob	No	5
57	Hack saw	No	5
58	Spirit Level	No	7
59	Rechargeable 30-watt power LED Flood Lights	No	3
60	Industrial Digital Thermometer	No	3

61	Digital Crane weighing scale with remote display & printer 5 t	No	1
62	Petrol Driven Light Weight Rail Drill machine with 52 kg & 60 kg Rail Adopter and 2 pairs of drills	No	1
63	Portable cutting machine (Handheld)	No	3
64	Chain Saw 18" or 24" for tree cutting	No	1
65	Aluminium Ladder 15 mtrs for cross track feeder checking	No	2
66	Oilver G Plus testing kit as per latest RDSO Specification	No	1
67	Electronic Distance measuring equipment up to 500 m clear vision	No	2

Note:

1. The above list is indicative and not exhaustive. If any additional spares, Tools & Test Equipment are required the same may be indicated by the contractor. However, nothing extra will be paid for any additional spares, Tools & Test Equipment indicated by the contractor.
2. The costs of spares, Tools & Test Equipment listed above for maintenance during DLP/AMC have to be included in the quoted prices. Nothing extra will be payable for such spares, Tools & Test Equipment.
3. If any additional spares, Tools & Test Equipment apart from the ones mentioned above are required during the DLP/AMC period the same will be arranged by the contractor, without any Extra Payments.
4. This will not absolve the contractor of his responsibility to fulfil the DLP/AMC obligations as per relevant clauses of tender conditions.
5. Contractor must ensure availability of above spares at all point of time. Any consumption of the same may be recouped within reasonable time with Tools & Test Equipment along with Test certificates, calibration certificates etc.
6. The requirement given above is indicative and minimum in nature (for guidance purpose only). Prior approval of engineer-in-charge will have to be taken before supply of spares, Tools & Test Equipment along with details regarding the make & model no. of items specified above.
7. Spares mentioned in list are indicative. Contractor shall propose the spares list (including any other spare part) to be maintained in Vehicles as per installed OHE in NGN section.
8. If any OHE spare is consumed at site, then it has to be recouped on the same day. For this Contractor must maintain sufficient reserve as per time required for procurement under his custody which shall be approved by Employer. All the above OHE T&P and Spares must be check with in the periodicity of 15 days.
9. These T&P and Spares shall become the property of employer at the end of Contract.

ANNEXURE – FP
CHECKLIST FOR FOOT PATROLLING MONTHLY FOR PAVED SECTION AND WEEKLY FOR GRADED SECTION

ITEMS	TO BE CHECKED
FOUNDATION (AT GRADE)	DAMAGED/CRACKED
	TILTED
	WATER COLLECTION AROUND FOUNDATION
	SIDE EARTH FILLING REQUIRED
	TOP OF FOUNDATION NOT VISIBLE
	WILD GROWTH, IF ANY
OHE MAST, TTC AND PORTALS	HIT MARK OR DAMAGE TO MAST
	NUMBER PLATE MISSING
	NUMBER PLATE DAMAGED/HANGING LOOSE
	CW HT./RL/IMP NOT PAINTED

ANCHOR	NUT CHECKNUT OR LOCK PLATE PIN MISSING FROM ANCHOR BOLT & GUY ROD.
	ANCHOR BOLT RUSTING
CANTILEVER ASSEMBLY	BRACKET INSULATOR DAMAGED
	STAY INSULATOR DAMAGED
	9 TONNE INSULATORS DAMAGED/SLIPPED
	ANY OTHER DEFECTS NOTICED, C/L ASSEMBLY DISPLUMBED
SECTION INSULATOR & PTFE NEUTRAL SECTION	ABNORMAL WEAR OF RUNNERS
	CORE INSULATOR VERY DIRTY
	CORE INSULATOR HAVING FLASH MARKS/DAMAGED
	ANY OTHER PART DAMAGED
REGULATING EQUIPMENTS	Y DISTANCE IS ABNORMAL
	FREE MOVEMENT OF BALANCE WEIGHT
	SS ROPE STRANDS FOUND CUT/CAGING
	WHETHER EQUALIZING PLATE IS TILTED
OHE SPAN	SPAN DROPPERS ABNORMALLY OUT OF PLUMB
	SPAN DROPPER, JUMPERS DAMAGED
	ANY ABNORMALITY IN RESPECT OF JUMPERS
	DAMAGED TO CATENARY STRANDS

	EXCESSIVE SAGGING/HOGGING OF CONT.WIRE
INSULATOR	INSULATOR NUMBER PLATE MISSING
	INSULATOR LOCK MISSING/DAMAGED
	CONDITION OF PEDESTAL INSULATOR
	ANY SIGN OF SPARKING/OVERHEATING
EARTHING	CONNECTION OF PLINTH JUMPER
	CONNECTION BETWEEN MAIN BEC TO PLINTH
	CONNECTION BETWEEN SEGMENT TO SEGMENT
	CONNECTION BETWEEN MAST TO OPC/BEC (AS APPLICABLE)
	CONNECTION BETWEEN MAST TO HAND RAIL.
	CONNECTION BETWEEN BEC TO STEEL STRUCTURE AT PLATFORM.
	CONNECTION BETWEEN FIRE WATER PIPE TO BEC IN PLATFORM
	CONNECTION BETWEEN IB OR ITL AND OPC, BEC,
GENERAL CHECKING	CAUTIONS BOARD MISSING
	TREE BRANCHES NEAR OHE (4 MTR.RANGE)
	POSITION MAST BASE PLATE BOLTS (AT VIADUCT)
	BIRD NESTS AND PIECES OF STRAY WIRE

	MINOR DEFECTS RECTIFIED IF ANY DURING PATROLLING (SUCH AS REMOVING OF KITES AND THREADS)
	MAJOR DEFECTS NOTICED, IF ANY

3. SCOPE OF WORK FOR DLP/AMC OF PSI & SCADA

During Defect Liability Period /Annual Maintenance contract, Contractor shall depute dedicated manpower round the clock in shifts prescribed in Table 1 at designated place as agreed by employer for attending breakdowns and preventive maintenance activities.

This shall be read in conjunction with Sub clause 10 of SCC applicable for DLP and AMC as well.

The following requirement is in addition to the responsibility of the contractor during DLP defined in Tender Documents.

S. No.	Staff Designation	No. of persons to be deployed	Min. Qualification
1	Sr. Engineer	1	Degree with 5 yrs. Experience of similar nature
2	Field Engineer	1 per shift	Degree with 3 years similar Exp./ Diploma with 5 years similar Exp.
3	Skilled	3 per shift	ITI with 3yrs. Similar Exp.
4	Un-skilled	1 per shift	-

Contractor shall set-up PSI Depot, corresponding stores, repair shops, which includes furniture, material racks staff cup-boards, tools, instruments, material handling instruments, communication instruments, material consumable etc. in addition to proper upkeep of all the installations in PSI.

Manpower mentioned above shall be able to perform duties as follows:

3.1. Duties and Responsibilities of Sr. Engineer (PSI)

Sr. Engineer (PSI) is the field in-charge of all the PSI installations including stores working under him and directly responsible for the safe and efficient maintenance of Traction Sub Station as well as Auxiliary power supply installations at ASS's including traction switching stations, SCADA installations etc. in his jurisdiction. He must be thoroughly conversant with all technical details of the equipment's under his charge including their rating, trend of power demand and correct method of their operation and maintenance.

In particular he/she shall responsible: -

1. To supervise the preventive and corrective maintenance of installations under his charge accordance with the standard and prescribed schedules to keep them fully serviceable all times and in a state of good repair. To ensure proper record of preventive and corrective maintenance of installations in his control and submit monthly report to Employer with completion and next due dates (Equipment wise);

2. To maintain proper co-ordination with CTPC/ TPC, OHE team, E&M team, Civil wing, Power supply authority and other concerned departments and render assistance when required to ensure reliability of power supply;
3. To ensure planning of preventive maintenance of PSI and submit in advance to Employer and ensure their implementation. To plan the requirement of power blocks for PSI maintenance based on the work to be done and submit the same well before to OCM through CTPC/ TPC and ensure for availing the complete section power blocks and completion of the work within the time allotted.
4. To keep his organization in constant readiness to deal promptly with any breakdowns and failures of equipment's; to attend any emergencies/ breakdown wherever and whenever required in a minimum possible time.
5. To instruct, train and supervise staff under his control and ensure that they shall operate and maintain the equipment properly and they actually observe all prescribed rules and regulations, Joint procedure orders issued time to time, safety precautions, SHE policy laid down, for this to ensure proper training of all the staffs working under him. Ensure provision of Personnel Protective Equipment's (PPE) while working on the systems for him and working staff as well.
6. To ensure that special tools and instruments for maintenance, and testing of all installations are healthy and carried for corrective and preventive maintenance, their timely calibration, storing at proper place etc. In addition to ensure that the program of testing and maintenance of protective relays in adhered to and ensure that other safety equipment including bonding and earthing are functioning effectively;
7. To monitor availability of sufficient quantity of spares and other store required for better maintenance and operation of the installations and initiate timely action to recoup of these items. Stock / Non-stock items planning, placement of stocking applications, submission of indents,
8. Ensuring availability of materials at all time and proper accountable and periodical verification of stores and T&P etc.
9. Ensure spare materials, T&P drawings, manuals and all other relevant literature etc. is available with him as per conditions of contract agreement.
10. To depute staff having competency when required for manning Substation, switching stations in the event of SCADA failure.
11. To inspect all installations under his charge at least once in three months and or as per prescribed scheduled inspection with attention to safety and operational aspects and submit the inspection reports to Employer without fail.
12. To keep Employer fully informed of all important development and seek their guidance when required.
13. To ensure proper taking over of new installation after arranging proper checking, testing, inspection and rectification of all defects, deficiencies and pending works and to ensure himself that installations are as per contract terms and conditions and as per all relevant standards and obtained approval for the same from the Employer.
14. To scrutinize daily reports on corrective and preventive maintenance activities, failures and other defects notices on PSI, as well as reports from CTPC/TPC, inspection report of Employer engineer and arrange prompt rectification of defects pointed out and report compliances to Employer and ensure their implementation.
15. To ensure submission of prescribed periodical reports after scrutiny and remedial measures suggested to avoid recurring failures and submit.
 - i. Failure analysis reports and unusual occurrence reports.
 - ii. Preventive and corrective maintenance progress.
 - iii. CB tripping reports with detailed analysis
 - iv. Power blocks and PTW reports.
 - v. Accidental reports.

- vi. Staff position report.
- vii. Store position report.
- 16. Submit reports to Employer on compliance of instructions issued by him if any.
- 17. To ensure proper competency with validity for the staff working under him and arrange training for issue of competency.
- 18. To ensure making of each equipment history, technical details updated and submit as and when required by the superior officers promptly.
- 19. Details of inspection schedules and the limit / tolerances must be displayed and kept ready at site.
- 20. To carry out all necessary inspections of his assets as per the statutory requirement or otherwise and shall notify and rectify any defects / deficiencies found during such inspections.
- 21. To follow all statutory regulations in force from time to time.
- 22. To carry out any other duties allotted by Employer related to work.

3.2. Duties and Responsibilities of Field Engineer

The Field Engineer/PSI will be under the Sr. Engineer/PSI and shall be responsible for:

1. Maintenance of the PSI and allied installations in his jurisdiction in accordance with the prescribed schedules.
2. Submission of the requirements of power blocks / track access for PSI maintenance, in co-ordination with OHE maintenance and other departments concerned as far as possible, to take maximum advantage of power blocks / track access.
3. Detailed inspection of PSI installations under his charge as per inspection schedules.
4. Scrutiny of daily foot patrol of cable routes, daily reports of defects and take prompt action to remedy the defects brought out.
5. Close supervision of maintenance gang under his control to ensure a high standard of work and compliance with prescribed schedules. To convey each preventive and corrective maintenance progress himself to CTPC/TPC as well as it should be written in the progress register of his headquarters.
6. Keeping the organization under his control in readiness to deal with break-downs and take prompt action to attend any failure and breakdowns following all safety rules and regulations.
7. Guidance to the maintenance staff for the proper execution of work in accordance with standing instructions.
8. Ensuring that tools and equipment's under his charge are properly cared for and maintained in proper condition.
9. Keep watch and take necessary and timely action to recoup stores and spares required for the upkeep of the system under his jurisdiction.
10. Preparation and submission of periodical reports and returns to superior officers as laid-down.
11. Ensure Employer Engineer is informed of all important developments and seeking their guidance when required.
12. Ensuring proper cleanliness of each equipment.
13. Keeping proper records of all reference drawings, manuals, maintenance schedule etc. for proper operation and maintenance of equipment's.
14. Ensuring safe working of maintenance personnel at site while doing of maintenance of equipment's.
15. Ensuring proper competency of the maintenance personnel before commencement of maintenance activities.
16. Ensuring proper records of inventory, testing and measuring tools etc.

17. Ensuring periodical checking / inspections of all testing tools, safety equipment's and measuring equipment's etc. timely and their rectification of deficiencies / defects notices, if any, and maintaining their proper records.
18. Carrying out any other duties allotted by Employer Representative related to work.

3.3. Duties of Working staff (Skilled)

1. All Skilled staff should have requisite Competency to enable their working independently and give report in written the work done assigned to them.
2. Every Skilled staff should be conversant with the safety rules pertaining to his work and be capable of independently attending minor repair and adjustment work on PSI. For this purpose, he is required to always carry his toolbox, communication equipment, other equipment's as required for cleaning, measuring, and lighting, safety equipment's (such as discharge Rod), ladder etc. with him.
3. A Skilled staff should be able to carry out operation at switching stations on local control in an emergency under the instructions of TPC.
4. Skilled staff should look for the common types of defects on PSI when they are deputed for patrolling work and to report on defects noticed during such patrolling to the Supervisors.
5. Every Skilled staff should develop the ability to carry out temporary repair in the event of breakdowns to restore traffic/supply as quickly as possible and to deal with repairs necessary for all types of breakdowns of PSI.
6. Make general check of Battery and Battery Chargers;
7. Make general check of earth connections;
8. The maintenance staff shall carry out the cleaning, oiling, bolting, servicing, minor adjustments and minor repairs, daily checks and other works as part of corrective and preventive maintenance.
9. Carry out any other duty assigned to him.

4. MAINTENANCE PROGRAMME

Contractor shall develop and submit maintenance program to achieve high reliability and ZERO DEFECT, and to ensure effective execution of the maintenance work for the approval of Employer. Document shall be based on the manufacturer recommendation and previous experience of the equipment installed in other railways/metros, O&M manuals, ACTM in force, General Rules for Metros, Safety Rules, Applicable Standards etc. Document shall include the but not limited to

1. Organization Chart for AMC
2. Maintenance activity
3. Periodicity
4. Detailed Procedures
5. List of Equipment's (T&P), spares to be used for maintenance including measurement instruments.
6. Checklists/ Registers/ Reports Formats
7. Precautions
8. Any other formats
9. Responsibilities.

The Contractor shall provide free of cost six weeks before start of trial running, spares, special tools and test equipment which are essential for day to day use in both corrective and preventative maintenance and for workshop use in the overhaul of all modules and units likely to be required over the full-service life of the installation as below. The Contractor shall submit a schedule of all tools and equipment with details of calibration and supplier and if this list is found insufficient then the same needs to be augmented for preventive and corrective maintenance of all the equipment supplied under the contract without any extra cost. These tools and test equipment shall become the property of employer at the end of DLP.

MINIMUM LIST OF SPARES, TOOLS & TEST EQUIPMENT (FOR PSI MAINTENANCE WORKS)		
A. TOOLS & TEST EQUIPMENT		
FOR 33KV ASS		
S.NO.	DESCRIPTION	QUANTITY
1	VACUUM CLEANER (WITH EXTENSION)	2 NOS.
2	AIR BLOWER	2 NOS.
3	LED TORCH	02 NOS.
4	INSULATION TESTER 5KV	1 FOR EACH STATION
5	HYDRAULIC OPERATED CRIMPING TOOL WITH DIE SUITABLE FOR INSTALLED SIZES OF CABLE	2 NO.
6	HYDRAULIC OPERATED CRIMPING TOOL WITH DIE SUITABLE FOR INSTALLED SIZES OF CABLE	1 NO.
7	COMPLETE MAINTAINER TOOL BOX WITH ALL TOOLS OF REQUIRED SIZES (SPANNERS, RING SPANNERS, SCREW DRIVERS, PLIERS, HACK SAW, HAMMERS, ADJUSTABLE WRENCH, ALLEN KEY SET, SPIRIT LEVEL ETC.)	4 NOS.
8	33 KV HAND GLOVES.	2 PAIR
9	HAND HELD DRILL MACHINE	2 NOS.
10	ALUMINIUM LADDER	
A)	4 FEET (A TYPE)	1 FOR EACH STATION
B)	20 TO 36 FEET EXTENDABLE WITH ROPE	1 FOR EACH STATION
11	FIRST AID BOX WITH MEDICINES	1 FOR EACH STATION
12	KEY BOX SUITABLE FOR 40 KEYS	1 FOR EACH STATION
13	HYDROMETER, RUBBER GLOVES, FUNNEL ETC.	1 FOR EACH STATION

14	FIBRE GLASS MEASURING TAPE (15 Mtrs.)	1 FOR EACH STATION
15	MULTIMETER	1 FOR EACH STATION
16	THERMAL CAMERA FOR OHE IMAGING	1 NOS.
17	CLAMP ON METER	2 NOS.
18	EARTH RESISTANCE METER	2 NOS.
FOR 25KV SWITCHING STATION		
19	EARTHING RODS	8 NOS. FOR EACH SW. STATION
20	ALUMINUM EXTENDABLE LADDER 11 MTRS	1 NO. FOR EACH SW. STATION
21	COMPLETE MAINTAINER TOOL BOX WITH ALL TOOLS OF REQUIRED SIZES (SPANNERS, RING SPANNERS, SCREW DRIVERS, PLIERS, HACK SAW, HAMMERS, ADJUSTABLE WRENCH, ALLEN KEY SET ETC.)	2 NO.
22	SAFETY BELTS	2 NOS.
FOR SCADA		
23	LAN TESTER	2 NOS.
24	OFC POWER METER	2 NOS.
25	HIGH PRECISION MULTIMETER	4 NOS.
26	Maintenance Laptop (i5, 8GB RAM, 500 GB HDD, 15" screen, Serial RS232 comm. port) installed with all maintenance & troubleshooting software with license	2 NOS.
27	OTDR METER	1 NOS.
28	EACH TYPE OF INTERFACE CABLE REQUIRED BETWEEN RTU & SERVER FOR TROUBLESHOOTING/ DOWNLOADING DATA FROM LAPTOP (USB TYPE)	2 NOS.

A. SPARE PARTS LIST (PSI)		
33 kV Equipment		
1.	CURRENT TRANSFORMERS EACH RATIO RATINGS	5 NOS.
2.	VOLTAGE TRANSFORMER	5 NOS.
3.	BATTERY CHARGER EACH TYPE	1 NO.
4.	BATTERY BANK EACH TYPE	1 NO.
5.	MCB FOR ACDB/DCDB OF EACH RATING AND TYPE	2 NOS.
SCADA		
6.	PLC	2 NOS.
7.	I/O CARDS OF EACH TYPE	2 NOS.
8.	POWER SUPPLY UNIT OF EACH TYPE	2 NOS.
PROTECTION & METERING		
9.	SET OF PROTECTION RELAYS CONSISTING OF ONE RELAY OF EACH TYPE	1 SET
10.	SET OF TRANSDUCERS CONSISTING OF ONE TRANSDUCER OF EACH TYPE	1 SET
11.	SET OF METERING RELAYS CONSISTING OF ONE RELAY OF EACH TYPE	1 SET
25KV SWITCHING POST		

12.	VOLTAGE TRANSFORMER, LIGHTNING ARRESTORS	2 NOS.
GENERAL		
13	LENGTH FOR EACH TYPE POWER AND CONTROL CABLE	1% OF THE INSTALLED QTY OR 100 MTRS. WHICHEVER IS HIGHER.
14.	STRAIGHT THROUGH JOINT KIT OF EACH TYPE	10 NOS.
15.	TERMINATION KIT OF EACH TYPE	10 NOS.
SCADA		
16.	OPERATING TERMINAL OR WORK-STATIONS OF SIMILAR HARDWARE AND SOFTWARE CONFIGURATION AS SUPPLIED AT OCC	2 SET
17.	SERVER OF SIMILAR HARDWARE AND SOFTWARE CONFIGURATION AS SUPPLIED AT OCC	2 SET
18.	PRINTER (LASER TYPE, A4 & A3)	1 NOS.
19.	PRINTER CARTRIDGE FOR EACH TYPE	10 NOS.
20.	SET OF LAN SWITCHES CONSISTING ONE SWITCH OF EACH TYPE AS SUPPLIED AT OCC	2 SET
21.	FIREWALL/L-3 ROUTER FOR CONTROL CENTRE	2 NOS.
22.	MEDIA FOR EXTERNAL BULK STORAGE DEVICE EACH TYPE	1 SET
23.	PROGRAMMING SOFTWARE (OF EACH TYPE ON CD WITH LICENSE)	1 SET

	(ONE SET CONTAINS ALL OCC/RTU SOFTWARE INCLUDING COMMUNICATION TROUBLESHOOTING SOFTWARE)	
24.	CAT 6 OR LATEST ETHERNET CABLE (ARMOURED)	500 MTRS.
25.	OPTICAL FIBER CABLE (SM, ARMOURED, FRLS-0H)	500 MTRS.
26.	LVDS LASER BANK MODULE	2 NOS.
27.	LVDS POWER SUPPLY AND ACCESSORIES	2 SET
28.	LVDS CONTROLLER GRAPHICS INPUT/OUTPUT/LAN CARDS	2 SET
29.	LVDS CONTROLLER POWER SUPPLY	1 NOS.
30.	KVM SWITCH (AS SUPPLIED IN OCC)	1 NOS.
31.	RTU RACK WITH ALL MODULES EQUIVALENT TO ELEVATED ASS RTU	4 SET
32.	RTU ETHERNET SWITCH	4 NOS.
33.	RTU MCB (OF EACH TYPE)	2 SET
34.	RTU POWER SUPPLY MODULE	4 NOS.
35.	VOLTAGE TRANSDUCER	4 NOS.
36.	RTU DOOR LOCK AND LIMIT SWITCH	4 NOS.
37.	INTERPOSING RELAY	10 NOS.
38.	EACH TYPE OF PATCH CABLE	5 SET

Note:

1. The above list is indicative and not exhaustive. If any additional spares, Tools & Test Equipment are required the same may be indicated by the contractor. However, nothing extra will be paid for any additional spares, Tools & Test Equipment indicated by the contractor.
2. The cost of spares, Tools & Test Equipment listed above for maintenance during DLP/AMC must be included in the quoted prices. Nothing extra will be payable for such spares, Tools & Test Equipment.
3. If any additional spares, Tools & Test Equipment apart from the ones mentioned above are required during the DLP/AMC period the same will be arranged by the contractor, without any Extra Payments.
4. This will not absolve the contractor of his responsibility to fulfil the DLP/AMC obligations as per

relevant clauses of tender conditions.

5. Contractor must ensure availability of above spares, Tools & Test Equipment along with Test certificates, calibration certificates etc.
6. The requirement given above is indicative and minimum in nature (for guidance purpose only). Prior approval of engineer-in-charge will have to be taken before supply of spares, Tools & Test Equipment along with details regarding the make & model no. of items specified above.

Minimum guidelines for Maintenance activities are broadly categorized as Follows:

- A. Preventive Maintenance
- B. Corrective Maintenance

For better utilization of traction assets, outage of any traction equipment from service should be minimum without compromising on safety of the equipment and personnel. Monitoring of condition of the equipment by reliable means (e. g. Thermographic camera) is essential for following system of need based maintenance i.e. directed maintenance.

Recommendations of Original Equipment Manufacturer (OEM) time to time, have to be kept in view while defining the scope and periodicity of the schedules.

4.1. Preventive Maintenance

1. Preventive maintenance is applied when equipment is still operative. In all such cases proactive treatment is given consisting of checks, examination and supervisory inspection. The frequency of maintenance given in following para is minimum. It may be increased based on factors such as site condition/ pollution levels and other system specific requirements.
2. To achieve high reliability and ZERO DEFECT, and to ensure effective checks on the maintenance work minimum schedules of inspections to be carried out.
3. The inspection schedule should be such as to cover all the installations in their jurisdiction within the stipulated periods and stagger the inspections among themselves to avoid over inspections of some installations time and again and neglect of other installations. A checklist in brief for various inspections is given.
4. The periodicity of the items of attention listed in the following paragraphs may be modified to suit local requirements with the approval of Employer.
5. About new equipment, if schedules have not been drawn up, tentative schedules may be evolved, based on the Original Equipment Manufacturer's guidelines and or any other benchmark, keeping in view the local conditions also and followed with the approval of Employer

4.1.1. Detailed Check Sheets for maintenance of PSI installations

Location	Installation	Quarterly	6 monthly	Yearly
ASS	Auxiliary Transformer	√	X	X
ASS	33 KV GIS	X	√	X
ASS	AC Distribution Box	X	X	√
ASS	DC Distribution Box	X	X	√

ASS	Battery Bank	√	X	√
ASS	Battery Charger	√	X	X
FP/ SP/ SSP/ SS	25 KV VCB / Interrupter / VT / LA and other Installations.	√	X	X
FP/ SP/ SSP/ SS	Motorised / Manual Isolators	√	X	X
FP/ SP/ SSP/ SS	Thermography Checks	X	√	X
ASS/ SS/ SP/ SSP/ FP/ ITL	Bonding and Earthing	X	X	√
SCADA ASS/SS/SSP/SP/FP	RTU, MIMIC panel	√	X	X
SCADA/OCC/RSS	Remote Control Centre	Monthly	X	X
Earth Quake Sensor	At Depot/RSS	As per recommendations of OEM		
Wind Speed Sensor	At Depot/RSS	As per recommendations of OEM		
Viaduct Lighting with Accessories	At Viaduct	As per recommendations of OEM		

Note: Scheduled inspections of the equipment's above are minimum. However, to ensure zero failure and enhanced reliability, safety, maintainability and economy, same may be reviewed by employer based on field reports, manufacturers recommendation etc.

CHECK SHEET FOR MAINTENANCE OF 33 KV/415V DRY TYPE AUXILIARY TRANSFORMER		
S.No.	Task	Quarterly
1	Date	
2	Location	
3	Equipment No.	
4	Note down the temperature of all three phases. Also observe for any abnormal sound, before power block.	
5	Obtain power block. Check the interlocking between LVCB, MVCB and transformer enclosure door.	
6	Clean enclosure, transformer and floor with vacuum cleaner. Blower not to be used for cleaning	
7	Check nut/bolts of HV/LV termination for tightness. Also check for sufficient clearance between delta cables/links. These should not touch each other.	
8	Visually inspect transformer, HV/LV connections for overheating, flash mark and discoloration of winding.	
9	Manually Check the working of temperature monitoring unit by lowering the setting of temperature, less than ambient temp. and verify the alarm and tripping of MVCB (Alarm=90°C, Trip = 120°C).	
10	Clean all temperature sensors with cotton cloth & tighten connections of control wiring in temperature sensor junction box & Temperature monitoring unit.	
11	Check the bolts of tap changer links for tightness.	
12	Check tightness of top & bottom insulated coil support.	
13	Check earthing strips for tightness.	
14	Check the surface of enclosure for any rust. Treat with touch up paint, if required.	
15	Manually Check the working of Cooling Fans, if available from temperature monitoring unit by lowering the setting of temperature, less than ambient temp.	

CHECK SHEET FOR MAINTENANCE OF 33KV GIS		
S.No.	Task	Half Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Check all the indicating lamps, meters, voltage indicators, relays visually before shut-down.	
5	Check the interlocking between LVCB, MVCB and Transformer door through castle lock.	
6	Check the breaker operation manually as well as electrically in local and remote, observe whether the mechanism functions smoothly without any rubbing or obstruction.	
7	Check for the operation of the emergency trip mechanically and electrically.	
9	Check Semaphore indicator for indication of Open/Close	
10	Check operation of Under Voltage relay of CB by switching off DC supply (if applicable).	
11	Check tripping of CB on over current by giving Test tripping command.	
12	Checking of three position switch operation & its indication in SCADA.	
13	Check the spring charging time.	
14	Check and note the pressure of SF6 in breaker chamber.	
15	Remove accumulated dust in the panel by Vacuum cleaner	
16	Check and note the pressure of SF6 in Bus chamber.	
17	Check all cable glands for proper sealing.	
18	Note the parameters in the relays i.e. current, voltage, log etc..	
19	Check the hinges, gaskets & door lock.	

20	Check the functioning of panel light and other accessories.	
21	Check for the functioning of heater & thermostat.	
22	Check the CT connections of CB for tightness. Also Record IR value of CT.	
23	Check Visually PT compartment for any abnormality & Check PT fuse/MCB.	
24	Check the earth strip connections for tightness.	
25	Check the functioning of counter operation and record the counter reading.	
26	Check all fasteners of Control Panel body for tightness.	
27	Visually inspect the panel body for rusting and paint, if required.	
28	Check Remote Operation by TPC before cancellation of Power Block. Check the working of spring cut off Limit switches.	

CHECK SHEET FOR MAINTENANCE OF AC DISTRIBUTION BOX		
S.No.	Task	Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Check:1. Status of earthing strip for tightness 2. Check for any sign of rust, apply touch up paint if required.	
5	Check the status of door for smooth closing and opening.	
6	Check the condition of door gasket, replace if required.	
7	Clean the exterior of ACDB box.	
8	Clean the dust, cobweb and foreign materials inside ACDB with the help of vacuum cleaner after switching off supply	
9	Check the healthiness of following indication: 1. ON/OFF 2. LED Under voltage relay	
10	Check for any flash mark/overheating or other abnormality of components	
11	Check and tighten all electrical connections	
12	Verify under voltage indication in SCADA from TPC by shorting the contacts as per wiring diagram for ACDB.	

CHECK SHEET FOR MAINTENANCE OF DC DISTRIBUTION BOX		
S.No.	Task	Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Check: 1. Status of earthing strip for tightness 2. Check for any sign of rust, apply touch up paint if required.	
5	Examine the status of door for closing and opening	
6	Examine the condition of door gasket, replace if required.	
7	Clean the exterior of DCDB box.	
8	Clean the dust, cobweb and foreign materials inside DCDB with the help of vacuum cleaner	
9	Check the healthiness of indication 1. ON/OFF 2. LED Under voltage relay	
10	Check for any flash mark/overheating/ other abnormality of components	
11	Check and tighten all electrical connections	
12	Verify under voltage indication in SCADA from TPC by shorting the contacts as per wiring diagram	
13	Check automatic changeover of Incomers-1&2 and coupler by switching incomers 1&2 off one by one. <i>(During changeover, CB will trip)</i>	
14	Check changeover operation of Incomers-1&2 and coupler by push buttons. <i>(During changeover, CB will trip)</i>	
15	Verify the change of status of on/off & Semaphore indicators during changeover in above mentioned steps	

CHECK SHEET FOR THE MAINTENANCE OF BATTERY BANK				
S.No.	Task	Quarterly	Half Yearly	Yearly
1	Date			
2	Location			
3	Equipment No.			
4	Measure the battery bank voltage after switching off both the battery chargers. It should be more than 110V			
5	Before starting maintenance on battery, wear gloves and goggles.			
6	Clean the accumulated dust using paint brush & dry cotton cloth over cell terminals, vent plug and cell body, starting from top to bottom row of cells.			
7	Check all battery inter cell links, cable connector and earthing connection for tightness. Replace with new/overhauled links if sulphation is found. Treat removed links with warm water & nylon scrubber in workshop.	X	X	√
8	Check electrolyte level (It should be between Max - Min marks. Top up with distilled water, if required).			
9	Check battery bank stand for any rusting, paint if required.			
10	Check each cell for leakage and bulging. If found, replace with new cell.			
12	After one hour of switching off battery charger, measure and record individual cell voltage. If voltage of any cell is less than 1.0 Volt, replace with new charged cell filled with sufficient electrolyte.			
13	Apply thin layer of petroleum jelly on battery terminals.			

14	Perform Discharge Test of Battery Bank and record the same. (For ex. NiCad Battery bank of 355 AH with 85 cells and each cell of 1.2 volt. With C5 rating i.e. at 68 Amp discharge rate with cut off voltage set at 85 volts (85 cells x 1 volt). It should give backup for 3 hrs. If capacity is less, then defective cell to be located by measuring the voltage of each cell and same cell should be replaced.	X	X	√
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CHECK SHEET FOR MAINTENANCE OF BATTERY CHARGER		
S.No.	Task	Quarterly
1	Date	
2	Location	
3	Equipment No.	
4	Observe the charger for any abnormal sound. Rectify the same if found.	
5	Measure the output voltage of the battery chargers. (Float voltage = 119.0V and Boost Voltage= 123.25V). Adjust the potentiometer, if any deviation is found.	
6	Check working of automatic changeover of the charger.	
7	Check working of alarm, indications, switches (Input, Output, auto/manual, float/boost) ammeter and voltmeter at charger as well as in SCADA.	
8	Switch OFF the charger, Open the cover and clean accumulated dust with vacuum cleaner.	
9	Check all cables (AC I/P & DC O/P) & earthing connection for tightness.	
10	Check the PCB Card and multi pin connector for any damage/heating mark. Clean PCB cards with soft hair brush.	
11	Check PCB cards and connections with IR camera for hot spots.	

CHECK SHEET FOR MAINTENANCE OF 25KV VACCUUM CIRCUIT BREAKER/ INTERRUPTER		
S.No.	Task	Quarterly
1	Date	
2	Location	
3	Equipment No.	
4	Obtain Power Block and provide earthing rod	
5	Open the cover of control box. Clean accumulated dust by vacuum cleaner. Also clean the sight glass.	
6	Check the operation in local and remote mode, keeping the front door open, observe whether the mechanism functions smoothly without any rubbing or obstruction.	
7	Check the working of counter and record the counter reading.	
8	Check electrical interlocking between CB and associated isolators both locally & remotely. Isolators should not operate when CB is in closed condition.	
9	Check for moisture entry inside the box. If found examine the door handle/gasket for any damage, replace if required	
10	Verify from SCADA status, the change of position of local/remote switch & open/close status.	
11	Remove castle key and switch off DC supply.	
12	Check the working of heater.	
13	Check all electrical connections of control panel for tightness.	
14	Check the bushing insulator for any chipping and flash mark and clean with cotton cloth. Anti-track paint should be applied on chipping/Flash marks.	
15	Check bimetallic strip between CB flange and bus bar connector.	
16	Check the incoming & outgoing connections for tightness	

17	Check the gap between sensor and sensor plate (Gap should be 1-3 mm)	
18	Check Spring stroke adjustment (Gap should be 2.5 - 5 mm in VCB closed condition)	
19	Check the IR value of the 110V DC motor with 500-volt megger (min. value - 1 mega ohm). Clean the commutator with muslin cloth. Examine carbon brushes for any damage.	
20	Check all nut bolt inside mechanism box for tightness.	
21	Apply touch up paint in case of rusting found inside or outside the control box.	
22	Check the earth strip connections for tightness.	
23	Check nut bolt of support structure for tightness.	
24	Check Remote Operation by TPC before cancellation of Power Block	

CHECK SHEET FOR MAINTENANCE OF ISOLATOR		
S.No.	Task	Quarterly
1	Date	
2	Location	
3	Equipment No.	
4	Obtain power block & provide earthing rod	
5	Check the operation electrically in local and remote mode ,keeping the front door open: a. Observe whether the motor gear mechanism functions smoothly without any rubbing or obstruction. b. Male and female contact should be in aligned position when isolator is closed, if not then adjust limit switch in control box.	
6	Check electrical interlocking between Isolator and associated CB both locally & remotely. Isolators should not operate when CB is in closed condition.	
	Press Manual push button & remove castle key. Isolator should not	

7	operate electrically after removal of castle key.	
8	Check operation with handle after placing castle key at other slot provided for opening of door slot for insertion of handle.	
9	After checking above operations, make sure that power circuit of motor is switched off.	
10	Clean the control box with blower.	
11	Check all wiring connection for any looseness and tighten if required.	
12	Check nut and bolts for any looseness and tighten if required.	
13	a) Check the clearance between male and female blades in open condition it should be ≥ 50 cm for vertical break isolators. Note the distance between male and female contact should be measured perpendicularly in case of vertical break isolator.	
14	Check the pedestal insulator for any chipping and dust. Clean with dry cotton cloth. In case of chipping apply anti-track paint.	
15	Check alignment of arcing horn provided on male and female contact of isolator. Adjust if required.	
16	Check proper alignment of male and female contact on fixed as well as moving end. There should be no air-gap between male contact and female spring leaf in close condition of isolator.	
17	Clean the contact with cotton cloth and apply thin film of petroleum jelly to the contact surfaces. Remove excessive jelly.	
18	Grease the main bearing in control box through grease nipple. The other rotating parts should be lubricated using Mobil oil.	
19	Measure and record insulation resistance of motor winding using of 500V megger. (IR>1M Ohm)	
20	Check Remote Operation by TPC before cancellation of Power Block	

CHECKSHEET FOR THERMOGRAPHY OF SS/SSP/SP/FP		
S.No.	Task	Half Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Check the temperature rise of cable termination, connecting jumper and clamps	
5	Check the temperature rise of incoming/outgoing clamps of isolator	
NOTE: - Temperature recorded should not be greater than 15 degrees centigrade of ambient temperature, if found same to be treated as hot spot and get it attended.		

CHECKSHEET FOR MAINTENANCE OF BONDING AND EARTHING		
S.No.	Task	Yearly
1	Check physically the soundness of bonding and earthing connection to every electrical equipment, structural steel etc. and inter-panel connections	
2	Check and record group/ combined earth resistance of the system	
3.	Check tightness of Earthing Strip on MET.	
4	Check tightness of connections between structure(s) and BEC	

CHECKSHEET FOR MAINTENANCE OF VOLTAGE TRANSFORMER		
S.No.	Task	Monthly/Quarterly/ Half Yearly/ Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Obtain Power Block and provide earthing rod	
5	As per DMRC ACTM Vol-2	

CHECKSHEET FOR MAINTENANCE OF LIGHTNING ARRESTER		
S.No.	Task	Monthly/Quarterly/ Half Yearly/ Yearly
1	Date	
2	Location	
3	Equipment No.	
4	Obtain Power Block and provide earthing rod	
5	As per DMRC ACTM Vol-2	

Note: In addition to be Maintenance Schedule and Check List as specified in DMRC ACTM VOL- 2 and other Maintenance Instructions as issued from time to time shall be followed.

4.1.2. Maintenance Schedule of SCADA System

A. Remote Terminal Unit Periodicity: Quarterly

1. Visual Inspection of LED status of CPU card, Communication Process Card, Power supply card, DI card, DO card, AI Card and power supply card Ethernet Switch.
2. Check the working and performance of power supply units and communication convertors.
3. Check close/open Operations and SCADA permissive of circuit Breaker, Isolator, Interrupters and BMs
4. Check Indications and alarms of Sub-station equipment's in SCADA along with PSI team at the time of CB maintenance.
5. Cleaning of RTU Panel.
6. Check the tightness of all cable terminations at the RTU panel.
7. Checking of CV2 relay, tightness of cable terminations, relay markings and observe for any arcing at relay contacts while command execution.
8. Checking the auto change-over function of L.T. Breakers through SCADA.
9. Check the Earthing connections and check for gland holes.

B. Remote Control Centre Schedule: Monthly

1. Take the application backup of SCADA software Database.
2. Check the Busbar colouring of the sub-station picture at the time of power block
3. Check the event updating and system supervision log
4. Check the updating of trends and measurement reports.
5. Check the Control Transfer function between OCC, BCC etc
6. Equipment cleaning of server, workstations, monitors, printers and communication cubicle.
7. Check for any malfunction, software or hardware error in servers, workstations.
8. Check all Power cables and communication cables connections for ensuring tight connections.

C. LVDS Panel Schedule: Quarterly

1. Check the indications of auxiliary and traction equipment's of LVDS panel.
2. Check for any malfunction, software or hardware error in LVDS Controllers and cubes.
3. Check all Power cables and communication cables connections for ensuring tight connections.
4. Cleaning of LVDS panel

4.2. Corrective Maintenance

Bottom line of carrying out preventive maintenance is that once it is carried out that equipment should not fail till the next schedule falls due. Generally, it shall be carried out during non-traffic hours on main line for 25kV Switching stations and for ASS as per availability of power block at station. Despite of above intense maintenance schedules and different proven power supply arrangements installed failures are observed. These failures are to be attended after taking power and traffic block (if required) of affected section/stations.

For attending breakdowns Contractor's PSI team should be ready at designated place all the time and immediately move to the place of breakdown/incident.

Unusual Occurrence report should also be submitted within 3 days to the employer in prescribed format.