





## **SAFETY POLICY**

TANGEDCO, involving in Generation & Distribution of Electricity in the State of Tamil Nadu, accepts its moral responsibility in providing safe and secure working environment to all its employees in construction, operation and maintenance of Electricity Distribution System and its associated Sub-Stations, including public as an integral part of its value system.

**“SAFETY FIRST - WORK NEXT”** is our motto which emphasizes that all work shall be taken up with utmost care giving top priority to safety. Safety will be inculcated in the mind of our employees so that Safe, Healthy and Accident free work place is created for themselves, their co-workers and to the General Public.

We believe that accidents are preventable through the continual improvement in the working environment and the active involvement of employees at all level. To make this happen, we will enhance the awareness, skill and competency level of our Field staff, Supervisors and Engineers with consistent & continual support and to make them feel responsible and accountable towards making TANGEDCO safe and accident free.

**Chairman-cum-Managing Director  
Tamil Nadu Generation & Distribution Corp. Ltd.**



## **FORE WORD**

Tamil Nadu Generation & Distribution Corporation Ltd, distributes electricity to entire state of Tamil Nadu covering more than 3 Crore consumers. The distribution wing works 24x7 to provide electricity to the consumers. Electricity is hazardous when not handled properly; hence proper safety education is a must for the employees who handle electricity. This manual covers the safety aspect that needs to be followed by the Distribution wing in their day to day activities.

This manual is designed to inculcate safety in the minds of field staff and to their controlling officers. All the controlling officers should take the responsibility of educating the content of this Safety manual to their field employees and must ensure the following of safe working procedures by them.

This Safety Manual (for Distribution works) has been compiled out under the direction of

**Er. R.Manivannan, Director (Distribution)**

by a team comprising the following members.

- **Er. B.Srinivasan, Executive Engineer / GIS / I.T.**
- **Er. L.K.Sankaran, Executive Engineer / O&M**
- **Er. A.Venkatesan, Executive Engineer / O&M**
- **Er. K.A.Murugan, Assistant Executive Engineer / O&M.**

**Chairman-cum-Managing Director  
Tamil Nadu Generation & Distribution Corp. Ltd.**

# Contents

Chapter No.	NAME OF THE CHAPTER	PAGE NO
	Preamble	1
	Definition	3
1	General Safety Requirements	5
2	Safety – Roles & Responsibilities	16
3	Electrical Personal Protective Equipment (PPE) and Tools	23
4	Safety in Distribution Construction Work	34
5	Safe Working in Sub-Station	57
6	Safe working in Operation & Maintenance of HT/LT Lines/Cables and Equipment	71
7	Effective Earthing practices to ensure safety	80
8	Safety in consumer premises	92
9	Standard Distances and Clearances	95
10	Prevention of Fire & Firefighting techniques	111
11	First Aid	128
12	Accident – Reporting & Auditing	136
13	Line Clear Permit	140
14	Safety Training & Awareness	150
	Annexure I - Form for application of Line Clear Permit	153
	Annexure II - Letter to consumer to provide adequate clearance	155
	Annexure III - Accident Reporting Form	157
	Annexure IV - Safety Audit, Field job audit report	165
	Annexure V - Warning check slip before attending FOC	167

## Preamble :

Tamil Nadu Electricity Board (TNEB) was formed on July 1, 1957 under section 54 of the Electricity (Supply) Act 1948 in the State of Tamil Nadu as a vertically integrated utility responsible for power generation, transmission and distribution. The electricity network has since been extended to all villages and towns throughout the State. As per the provisions under the section 131 of the Electricity Act, 2003 TNEB was restructured on 1.11.2010 vide G.O.Mo.No.100 dt.19.10.2010 into TNEB Limited; Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) and Tamil Nadu Transmission Corporation Limited (TANTRANSCO).

As per Indian Electricity Rules 1956, TNEB published its Electrical Safety Manual for Generation, Transmission and Distribution in the year 1965, in order to emphasize Electrical safety in the regular day to day work for its employees. This manual along with its amendments existed for nearly six decades.

The Indian Government (Ministry of Power) has enacted, "**The Electricity Act 2003 (36 Of 2003)**", with effect from 10.06.2003 repealing the erstwhile, "Indian Electricity Act – 1910, Supply Act 1948 and Electricity Regulatory Commission Act 1998".

In Section 185, subsection (2) clause (c) of the act, it is stated that, "The Indian Electricity Rules 1956 made under section 37 of the Indian Electricity Act 1910 (9 of 1910) as it stood before such repeal shall continue to be in force till the regulations under section 53 of this act are made".

In exercise of the power conferred by clause (c) of section 73 read with subsection (2) of section 177 of the Act, the Central Electricity Authority New Delhi, made the regulations called "Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010" and "Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations, 2011". The regulation so formed by the authority along with its amendments replaces the Indian Electricity Rules 1956 and shall apply to all electrical plants and electric lines already commissioned as well as those under construction.

In section 4 (c) & 5 of Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations - 2011, it has been directed to prepare a detailed safety manual covering topics detailed in Annexure I & Annexure II of the above regulation.

Section 16 (3) (j) of Tamil Nadu Electricity Distribution Code specified by Tamil Nadu Electricity Regulatory Commission (TNERC) mandates preparation of a Safety Manual incorporating all operating procedures in addition to safety rules and safety precautions applicable to distribution system and the consumer's system and circulate the same among all staff concerned and consumers for strict adherence.

Hence, in order to comply with the directions issued by the Central Electricity Authority and the State Regulatory Commission, and to revise the six decades old Safety Manual to cover the topics specified in Annexure- I & Annexure - II of Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations - 2011, this Safety Manual has been prepared, incorporating relevant codes, regulation and all instructions issued from time to time relating to safety.

This Safety Manual deals with the General & Special safety requirements that needs to be followed while carrying out Construction, Operation & Maintenance of Distribution Network and its associated Sub-Stations of TANGEDCO.

The voltage level covered under this manual is

Low Tension (LT) – Up to 250 V

Medium Voltage(MV) – exceeding 250 V up to 650 V

High Tension (HT) – above 650 V upto 33 KV

## Definitions

To clarify the intent and meaning of the wording used in this Safety Manual, the following definitions are given. All words / expressions used herein and not defined shall have the meanings assigned to them in the Indian Electricity Act – 2003 and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010, Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations-2011 and its amendments.

1. "Accident" may be defined as an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury, or loss of life.
2. "Act" means the Electricity Act 2003 (36 of 2003)
3. "Regulations" means Central Electricity Authority (Measures relating to safety and electric supply) Regulations, 2010.
4. "Authority" means a body to be called the Central Electricity Authority to exercise such functions and perform such duties as are assigned to it under section 70 of Electricity Act 2003.
5. "Apparatus" means electrical apparatus and includes all machines, equipments, fittings, devices accessories and appliances in which electricity is used.
6. Bare conductors (of an overhead line) means a wire not insulated from one another, suitable for carrying an electric current and which can be arranged as to be electrically connected to a system.
7. "Circuit" means an arrangement of conductor or conductors for the purpose of conveying electricity and forming a system or a branch of a system.
8. "Commission" mean Tamil Nadu Electricity Regulatory Commission
9. Conductor means any wire, cable, bar, tube, rail or plate used for conducting electricity and so arranged as to be electrically connected to a system.
10. "Danger" means danger to health or danger to life or any part of body from shock, burn or other injury to persons, or property, or from fire or explosion, arising out from working on generation, transmission, transformation, conversion, distribution or use of electricity.
11. "Earthed" or "connected with earth" means connected with the general mass of earth in such manner as to ensure at all times an immediate discharge of electricity without danger.
12. "Earthing System" means an electrical system in which all the conductors and appliances are earthed.

13. "Electrical shock" is an unwanted or unnecessary physiological response to electric current.
14. "Fuse" is a safety device in an electric circuit which melts when there is a fault so that the flow of electricity stops..(or) a safety device that operates to provide protection against the overflow of current in an electrical circuit.
15. "Insulators" are used to provide necessary insulation between line conductors and supports to prevent the leakage current from conductor to Earth.
16. "Isolator" is a device used for isolating a circuit or equipment from a source of power.
17. "Lightning Arrestor" is a protective device which conducts only the high voltage surge on the power system to ground.
18. "Live" means electrically charged.
19. "Near miss" a narrowly avoided accident.
20. "Occupier" means the owner or person in occupation of the premises where electricity is used or proposed to be used.
21. "Poles" means the phase terminals of a switch.
22. "PPE-Personal Protective Equipment" such as hand gloves, gauntlet, waist belt rope, Earth / Discharge rods, helmets etc. used for personal protection.
23. "Safety Gloves" are the protective material used by the workmen while working with Electrical equipment.
24. "Span" means the horizontal distance between two adjacent supporting points of an overhead conductor.
25. "System" means an electrical system in which all the conductors and apparatus are electrically connected to a common source of electric supply.
26. "Point of Commencement of Supply of Electricity" means the point at the incoming terminal of the switchgear installed by the consumer.
27. "Safety working clearance" is the minimum clearance to be maintained in air between the live part of the equipment on one hand and earth or another piece of equipment or conductor on which it is necessary to carry out the work, on the other.
28. "Breaker / Circuit Breaker" is an electrical switch designed to protect an electrical circuit from damage caused by over current / overload or short circuit.
29. "Switch" responds to an external force to mechanically change an electrical signal.



# CHAPTER - 1

## GENERAL SAFETY REQUIREMENTS

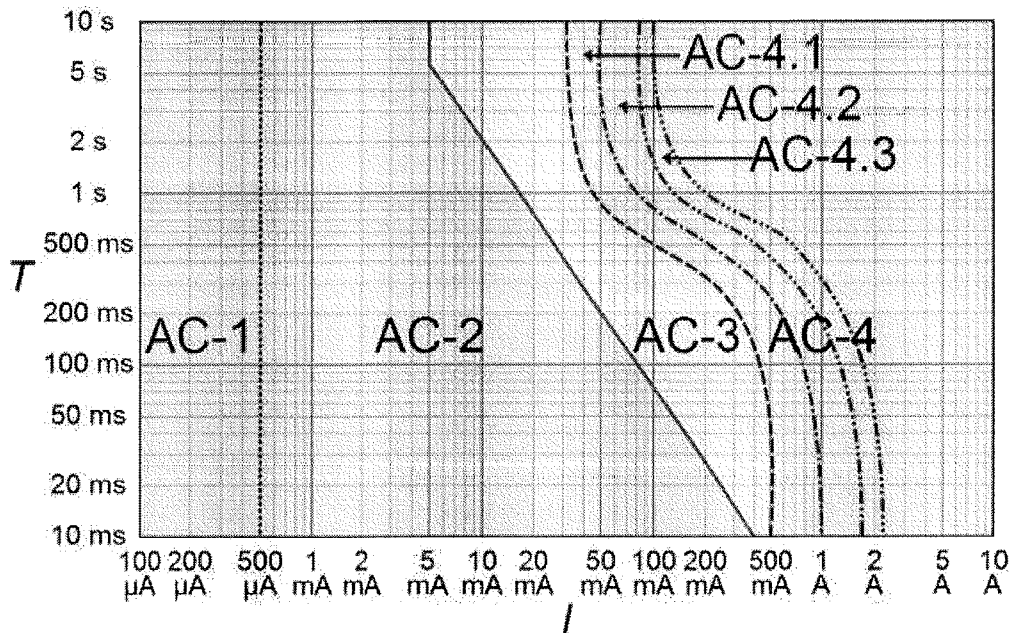
Electrical safety is a system of organizational measures and technical means to prevent harmful and dangerous effects on workers from electric current, electric arc, electromagnetic field and static electricity.

Electrically powered equipment can pose a significant hazard to workers, particularly when mishandled or not maintained. The major hazards associated with electricity are electrical shock, fire, arc flash, burns, death and damage to the properties.

Electrical shock occurs when the body becomes part of the electric circuit, either when an individual comes in contact with both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor.

The severity and effects of an electrical shock depend on a number of factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet or dry.

The effect of the shock may range from a slight tingle to severe burns to cardiac arrest. The chart below shows degree of injury to a human being caused by alternating current (I) of duration (T) passing from left hand to feet as defined in IEC publication 60479-1



- AC 1      imperceptible
- AC 2      perceptible but no muscle reaction
- AC 3      muscle contraction with reversible effects
- AC 4      possible irreversible effects
- AC 4- 1    up to 5% probability of ventricular fibrillation
- AC 4- 2    5-50% probability of fibrillation
- AC 4- 3    over 50% probability of fibrillation

A hazardous arc flash can occur in any electrical device, regardless of voltage, in which the energy is high enough to sustain an arc. Potential places where this can happen include:

- Panel boards and switchboards
- Motor control centres
- Metal clad switchgear
- Transformers
- Motor starters and drive cabinets
- Fused disconnects
- Any place that can have equipment failure
- Short circuits
- Loose connections in current carrying path
- Improper handling of AB switches
- Aged conductors & Line materials

In an arc flash incident, an enormous amount of concentrated radiant energy explodes outward from electrical equipment. The explosion creates pressure waves that can damage a person's hearing, a high-intensity flash that can damage their eye sight and a superheated ball of gas that can severely burn a worker's body and melt metal.

An Electrical Accident is an undesirable, incidental, and unplanned event that occurs due to unsafe condition or negligence of safety measures by an individual. Safe working means, working in an Electrical system without causing any damage or injury to themselves; to their co-workers; to general public; or to the equipment maintained by him. Safe working measures eliminate or minimize the hazards of electricity.

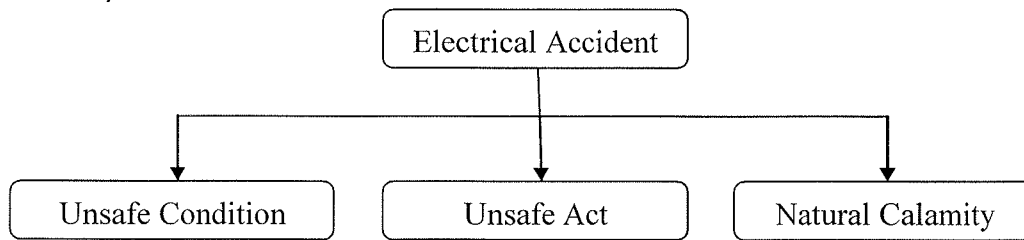
To an individual an electrical accident can cause temporary reversible ailment, permanent irreversible handicap or even loss of life. Accident can lead to financial loss for recovering from ailment and also an accident victim losses his confidence level of working.

To an organization, an electrical accident can cause loss of skilled workman, delay in completion of work, financial loss by payment of compensation, facing of judicial procedures etc.

To a family, loss of life of a member inflict irreparable loss

## **Reason for Accident**

An Electrical accident can happen because of, unsafe environment, unsafe act or natural calamity.



### **Unsafe Condition :**

Unsafe condition or work environment which causes accident includes the following.

- Presence of corroded poles
- Presence of All Aluminium Conductor/ aged conductor
- Working on corroded line poles or structure poles
- Working on poles without stay wire or temporary stay
- Working on lean poles.
- Lines / structures without standard ground clearances
- HT / LT Lines in a pole without standard clearances.
- Improper horizontal crossing of HT / LT line.
- Improper termination of cut points in LT line / HT line.
- Insertion / removal of a pole in an existing line without the arrangement of Temporary stay.
- HT/LT lines in a pole with LT supply from different HT supply.
- HT/LT lines in a pole of different HT feeders.
- LT line with street light supply from different transformer
- Mixing of neutral between two transformers
- Return supply from improperly connected generator / inverter of consumer.
- Sag in conductor because of long span of pole or leaning of pole
- Line without strut / stay resulting in excess sag
- Non availability of guarding.
- Use of defective material such as poorly constructed scaffolding, broken ladder, torn gloves, old belt rope etc.
- Nonstandard design / construction practice of lines, structure etc.
- Improper earthing or non-maintenance of earthing in structure lines and switchyard.
- Control cable and power cable running together.
- Allowing a person to work at a height without the presence of any supervisor or co-worker.
- Improper illumination while working on a structure/outdoor/ yard during night time.
- Nonstandard / oversized fuse provided in HG fuse or LT Feeder fuse.
- Slippery/wet conditions
- Non usage of U jumpers in lines in tapping points

- Non maintenance of AB switches, equipments.

### **Unsafe Act :**

Safety as a whole may be interpreted as the proper planning of work, proper usage of safety tools, following safety procedures and exercise of good judgment and careful supervision. Experience proves that majority of the accidents are preventable. Prevention of accident requires the whole hearted co-operation of all employees of the organisation.

Accident does not just happen, it happens because of unsafe or careless act of an employee or a group of employee carrying out a work. The following are the unsafe acts which may lead to an accident.

- Lack of knowledge on the existing incoming & outgoing supply, back feeding arrangements etc. All the employees working in an electrical system must be aware of the complete feeding arrangements and also must be aware of any changes in the feeding arrangements that have been carried out during his absence.
- Opening one Distribution Transformer and climbing the LT pole of different Distribution Transformer.
- Ignorance of safety procedures and negligence in usage of personnel protective equipments (Hand gloves, gauntlet, Waist belt, Earth rod and Helmet).
- Over confidence in working. Working with confidence is very important in an electrical system but it must not be with overconfidence. Overconfidence will lead to negligence of safety concepts.
- Working with assumptions must be avoided. Any work must be started only after obtaining proper confirmation from authorized employees/authorities.
- "Failure to plan is planning to Failure" Hence any job must be well planned and discussed with all the team members about the role to be played by each member of the group for safe execution of work.
- Adopting improper communication method like waving of hand, showing signs etc. A work has to be commenced only after proper communication and assuring the same through feedback.
- Working with urgency to complete a job.
- Working without properly isolating the work area from electricity, like working without opening AB switch, without removing fuses etc. and without proper discharge.

- Working after opening the AB switch but without confirming its opening conditions and without proper discharge.
- Working without obtaining proper Line Clear (LC).
- Taking unsafe position or posture while lifting heavy material and failure to observe the surroundings while using a crane during construction / maintenance work.
- Working without safe working clearance.
- Distracting, teasing, horseplay, quarrelling or annoying in the workplace.
- Usage of mobile phones during work time. Mobile usage may distract the concentration of a worker and hence it must be strictly avoided.
- Working with alcoholic intoxication must be strictly avoided.
- Working carelessly or without adequate training / knowledge in the procedure to work safely must be avoided.
- Throwing up or throwing down of hand tools while working in a height on lines or structure. All small tools must be raised or lowered by means of hand line and canvas bucket only. Men on the ground must wear helmet or stay clear of overhead work to prevent being stuck by falling objects.

### **Natural calamities**

Natural calamities are unpredictable and can cause damages to the public as well as properties. Natural calamities may be due to

- Heavy wind
- Heavy rain
- Flood
- Earthquakes
- Landslides; road breaches
- Fire
- Chemical hazards
- Cyclone
- Tsunami

The above natural calamities may cause damage to the poles, conductor and all electrical equipments / installations.

## **Safe Working Procedure :**

In order to work safely in electrical system, the following procedures, popularly known as ABCDE of Safe Working shall be followed.

### **A – Aware**

Before starting any work, the team which is going to carryout the work has to be aware of the following. It is necessary that all the individual irrespective of cadre must be aware of it.

- Where to work.
- What is the nature of work
- Sources of Supply available at the work spot.
- Whether supply is under normal feeding or back feeding.
- Where to isolate
- Whether LC is required.
- Materials required for the work
- Which DT has to be isolated
- In which HT line LC has to be taken
- Whether isolation from generator / UPS available is needed
- Time required for the work
- Brief description on the procedure to carry out the work safely and in an efficient manner

### **B – Break :**

Breaking the supply in the work spot is an essential step for safe working. Therefore it is necessary to

- Switch off the correct circuit on which the work has to be executed.
- If AB Switch has to be opened to break the supply, then proper gloves has to be worn and also it must be ensured that the Operating rod is earthed properly.
- If the work spot is away or not in the vicinity from the transformer structure, a lock shall be provided at the handle to lock it in Open condition.
- If LC has to be obtained then it must be obtained by competent persons after following the standard LC procedure defined in this manual.

## **C – Confirm :**

Any work has to be carried out only after proper communication and on receipt of permission from the competent authority.

- If AB switch is opened to break the supply then it must be confirmed that all the three blades of (R,Y & B) phases are completely opened and necessary clearance between the blade and contact is available.
- It must be confirmed all the incoming and outgoing jumpers of AB switch in all the three phases are intact.
- If LC is obtained, then before commencing the work it must be ensured in the field that the supply has been interrupted only for their cause and not because of any faulty feeder trip / Load shedding / breakdown of any other equipments.
- It should be confirmed that no supply from the generator/UPS is extended to the work spot.
- Before commencement of work, the field condition like proper clearances, any abnormal wire cuts etc must be observed and then only the work has to be started.
- If LC on HT line is to be obtained, name of the feeder should be correctly mentioned in the LC application/LC permit.
- Appropriate /Correct Circuit breaker should be tripped with bus/line switches opened for the line mentioned in the LC permit.
- Appropriate / Correct DT must be opened for the FOC/LT line works.
- Appropriate / Correct DP must be opened for HT line work to isolate the work spot.

## **D – Discharge:**

Even though supply to a circuit has been interrupted, there will be stagnation of electric charge which will be sufficient to cause danger to an individual who comes into contact with it. Hence it is necessary that after breaking a supply, discharging has to be done safely and completely.

- Discharging has to be done by using a standard discharge rod by the person standing at ground level.

- Care must be taken to ensure that the discharge rod wire is at least 0.75 m away from the body.
- The discharge rod shall be brought near to the circuit slowly and if any arcing or flash over is noticed then it shall be withdrawn immediately.
- A report on such arcing / flash over shall be made to the person who issued the LC.
- Each & every one of the individual conductor(including Neutral in case of LT) shall be discharged as above.
- The leads used for discharging shall be tested for continuity before use and is of stranded flexible conductor instead of solid wire and it must be of copper.

### **E – Earthing :**

Earthing is lifesaving measure which protects an individual in the event of any wrong/accidental charging of the circuit in which a work is carried on. No work shall be commenced without earthing.

It must be clearly kept in mind that any work how small it may be, it has to be carried out, only after proper earthing. The standard procedure of earthing is explained in chapter (11) of this manual, and this has to be strictly followed.

- ✓ Earthing shall be done on both the sides (incoming & outgoing) at the place of work.
- ✓ Short circuiting shall not be treated as a substitute for earthing. Standard earth rods shall be used.
- ✓ The earthing and discharging shall be done by an authorized person only.
- ✓ The earthing kit consists of 3 No wooden rods with clamps on top of each, designed for securing and holding tightly with the line or droppers. From each of the above top clamps, leads are brought down and bunched together. While providing earthing the leads connected in the earth rods have to be connected directed to earth pipe / spike first and after that only all the rods have to be connected with the lines / droppers.
- ✓ If there is no earth nearby, a temporary earth shall be provided by driving a metal spike to a depth of at least 3 feet.
- ✓ While removing the earthing, the earth rod shall first be removed from the spot and after all the earth rods are so removed, the connection to the earth pipe or spike shall be removed finally.
- ✓ The earths shall be placed in such a manner that they will not be detached



inadvertently due to movements of men and other causes.

- ✓ In the case of lines meeting or crossing at any poles on which work is to be taken up, all the lines crossing or ending at this pole shall be earthed.
- ✓ The earth rod leads shall not be tied with stay wires for the purpose of earthing.
- ✓ All conductors shall be treated as alive unless and until they are earthed properly.
- ✓ Earthing shall never be done or removed by bare hands.

### **General Instructions for Safety :**

#### **Safety Manual :**

In each and every offices of Distribution and Sub Stations of TANGEDCO, it must be ensured a copy of this Safety Manual is available (In English & Tamil). This must be made accessible to all the employees when needed. While conducting safety awareness programs the topics in this manual must be covered.

The Section Officer, Foreman & Line Inspector of a Distribution Office are jointly responsible for implementation of Safety rules and procedures among the workers.

#### **Smoking :**

Smoking is strictly prohibited in the work premises. Also smoking inside the battery room or carrying open fire torch inside the battery room is severely punishable.



#### **Personal Conduct**

Drinking alcohol or consuming any type of intoxicants, while on duty is strictly prohibited. No employee shall be under the influence of such drink or drugs while on duty since it renders him / her incapable of discharging his/her duties properly and efficiently. Any employee found drunken during his/her duty hours shall be severely punished.

Employees shall be courteous and considerate towards public and each other. They should be disciplined particularly when engaged in work.

Employees shall not needlessly enter other area / places where they have no business unless permitted.

Indulgence in jokes, mocking, betting, scuffling, flippant conversation barreling and wrestling while on duty or off duty on Board's properties or in Board's vehicle is forbidden. Unnecessary talks shall be avoided and mind shall be focused only on work.

### **DRESS CODE**

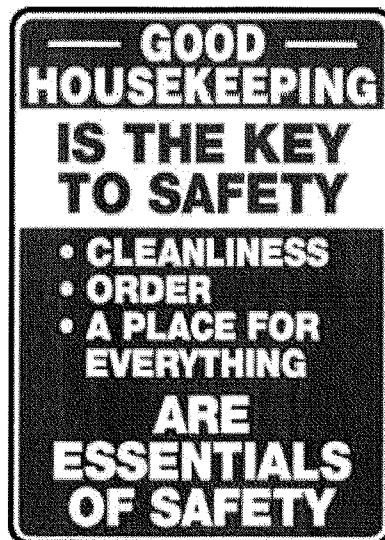
- Workers should wear the uniform provided to them.
- Workers should not wear loose cloths
- While working on live conductor they should not roll up sleeves as dry cloth gives some protections against shock.
- They should not wear suspenders and arm bands with metal buckles or other metal parts; these might come in close proximity to live parts and may cause injury.
- Workers should not keep any items like mobile phones, watches, valuable items etc. in their pockets while working in heights as they may distract the concentration.

### **Lifting of Loads**

- No attempt shall be made to lift the loads beyond their capacity. Employees should avoid twisting or excessive bending when lifting or setting download.
- Pushing should be resorted to when moving a load horizontally, rather than pulling.
- No one shall stand or pass under any suspended load being handled by a crane.
- Most lifting accidents are due to improper lifting method rather than lifting too heavy loads. When lifting heavy loads the back should be kept close to vertical and the lifting done with leg and arm muscles rather than with back muscle.
- Whenever and wherever possible accessories such as block tackles, jacks, bars etc. shall be used instead of lifting by hand.
- It shall be checked whether all the required tools and tackles are in good working condition before taking up the work. Only proper tools shall be used for each job.
- Each tool must be visually inspected before and after use. Defective tools shall be rejected.

## **House keeping**

- The place of work, both within the building and around the work area in switch yard, should be kept neat and clean.
- The work place organization method of 5s (sort, set in order, shine, standardize and sustain) should be adopted.
- Handling and usage of flammable liquids, oils, cleaning solvents should be carried out as per the prescribed manner so that they will not become the potential source of fire hazard.
- Pathways, stairways, fire escapes surrounding area near the distribution boards, control panels etc and all other passage ways shall be kept clear from all obstacles.
- Fused tube lights, bulbs and broken insulators must be safely disposed off without causing any injury.
- Each workman shall be responsible for leaving his work area clean and tidy.



## **Physical fitness**

Any employee who is unable to perform his duties due to illness or other disability shall promptly report his condition to his immediate supervisor.

Any employee who is mentally stressed and is in sick condition should inform it to their supervisors and refrain themselves from sensitive jobs.

## CHAPTER - 2

### SAFETY – ROLES & RESPONSIBILITIES

Success of any plan / method depends on the way in which it is implemented or enforced. Hence an enforcement mechanism viz., Creating safe working conditions, eliminating existing unsafe condition and to develop safe working habit in the minds of each and every employee must be chalked out and implemented scrupulously.

The roles & responsibilities at each level of distribution wing of TANGEDCO is described below.

#### **Safety Committee :**

- At the corporate level the Safety Committee shall be headed by The Chief Engineer / Planning & RC.
- The Safety Committee has to ensure effective implementation & monitoring of the steps taken to create safe working environment and to reduce the accidents / near miss incidents. The committee shall have close monitoring and analyse the accidents occurred and shall come out with suggestion to avoid recurrence of the same.
- The Committee must conduct a detailed safety review meeting once in every six months along with the Regional Safety Officers and discuss regarding the major/fatal accidents that happened in their Region and discuss measures to avoid recurrences
- Necessary Safety Instructions and procedures as required from time to time have to be issued by the Committee.
- The Committee has to ensure the availability of the Safety Manual right from the section level.
- The Committee shall conduct a periodic review on the content of the Safety Manual for the correction / updation / addition of the manual.

#### **Regional Level :**

Each and every Distribution Region of TANGEDCO must have a Safety Officer in the cadre of Assistant Executive Engineer / Electrical. The Safety Officer must be familiar with distribution safety aspects, provisions in Act, Regulations etc. His / Her roles and responsibilities are as follows.

- Safety officers shall be the Inspecting officer of all the apparatus of distribution network regarding safety.

- Any accident in his Region must be investigated by the Safety Officer and reports in the prescribed format must be prepared and submitted to concerned authorities.
- Ensuring the supply of quality PPEs (Earth rods, Rubber Gloves, Waist belt, Raincoat, Helmet & Uniform etc.) to all the employees in his Region.
- Conducting safety awareness programs periodically in region and motivating the staff towards accident free environment.
- Ensuring safety classes are conducted at specified intervals by all levels of the officers in the region.
- Has to ensure that a copy of safety manual is available in all the section offices of the Region.
- Conducting surprise inspections in the Distribution network of section offices and associated sub stations to conduct safety audits. Any alarming/ unsafe conditions noted must be reported to Superintending Engineer of Electricity Distribution Circle and corrective measures taken in this regards must be followed up.
- Chief Engineer /Distributions must review every month the statistics of existing unsafe conditions, action plan, fulfilled previous month, target of the next month in the region, procurement of required materials etc.

### **Circle Level :**

The Assistant Executive Engineer in Superintending Engineer/Distribution office looking after the accidents must be familiar with distribution safety aspects, provisions in Act, Regulation etc.

- Conducting safety awareness programs periodically in circle to impart proper safety training and create safety awareness among the employees.
- Reviewing safety class conducted register in sections, subdivisions, divisions to ensure whether safety classes are conducted to the employees periodically
- Any accident that has happened in a circle must be investigated by the AEE concerned and report to be sent to Safety Officer of the Region through Superintending Engineer.
- Superintending engineer must review every month accidents, near-miss accidents occurred in circle, unsafe conditions like, corroded poles, loose sags, feeder tripping etc. and chalk out the action plan to convert all the existing unsafe conditions to safe conditions and shall take corrective steps.

## **Division Level :**

- The Divisional Engineer / O&M has to ensure that safety is strictly followed without compromise while carrying out work in the field. Any unsafe act or unsafe condition must be seriously viewed and suitable corrective measures must be taken then and there.
- The Divisional Engineer must ensure that uniforms and quality PPEs are made available to all the employees of his/her division and they are using it on work.
- The Divisional Engineer must conduct safety awareness programs once in 6 months in the division to impart proper safety training and create safety awareness among the employees as stipulated in Chapter 14 of this manual.
- The divisional engineer must review the safety class conducted register of all Sections periodically.
- The division engineer should arrange training on First aid for every six months with the help of Red Cross Society.
- During temple car festival, the Divisional Engineer must ensure safe conditions and organize the plan to ensure accident-free conduct of the festival.

The divisional Engineer must ensure by frequent field visit and periodical review that the following unsafe conditions does not exist in his/her division.

1. Neutral mixing between adjacent DT's.
  2. Street light wire mixing between adjacent DT's.
  3. Street light wire running, through the DT structure from one side of the DT to other side (either side should have separate switching point and meter).
  4. Presence of All aluminium conductors / Aged conductors.
  5. Presence of low sag
  6. Presence of leaned pole
  7. Presence of stay-cut locations
  8. Presence of corroded/ damaged pole.
- The Divisional engineers are responsible for supply of adequate quantity of earth pipes. Line separators (spacers) for single phase and three phase OH network to avoid snapping of LT conductors.
  - The Divisional Engineers are responsible to ensure that the operating instructions is issued and updated in every substation, control centers in his/her divisions.
  - The existing operating instructions must be periodically reviewed by the Divisional Engineer and if any change due to additional equipment or revision of operational procedures, must be incorporated with due written authentication of the Executive engineer with intimation to

the MRT wing and Superintending Engineer.

- Divisional Engineer must sanction estimates, only if the proposal satisfies all norms of standard erection practices and CEA safety regulations.

### **Sub Divisional Level**

- The subdivision officer must conduct safety class every month or one of the sections of the subdivisions on rotational basis. as stipulated in Chapter 14 of this manual.
- Whenever Line clear is availed in 33KV SS, the concerned AEE shall be present in the SS and supervise the work especially in the safety aspects.
- The Assistant Executive Engineer / O&M has to ensure that safety is strictly followed without compromise while carrying out work in the field. Any unsafe act or unsafe condition must be seriously viewed by him/her and suitable corrective measures must be taken then and there.
- The Assistant Executive Engineer / O&M is responsible for the safety aspects of all the TANGEDCO substations within his/her jurisdiction. PPE for sub stations and availability of charged fire extinguishers etc. must be ensured by him.
- The subdivision officer must ensure that the possibility for HT or LT line snapping is completely eliminated in all sections of the subdivision.
- The HT line and LT line must be maintained free of tree branches. The sub division officers must review the tripping register every month, analyse the cause of tripping and eliminate them. Special line patrol must be organized in case of more tripping in a feeder, identify the fault location and rectify them.
- In case of LT Lines all measure to avoid snapping of conductors must be taken. The AEE/O&M must organize the pole to pole inspection of LT line in all DTs of Sub division, identify the presence of all Aluminium conductor, aged conductor, loose sag, long spans etc. and rectify them.
- The AEE/O&M must ensure that all DTs are provided with proper and effective neutral earthing by frequent field visits.
- Adequate quantity of earth pipes and correct size of LT fuse wire must be identified periodically and provided to all sections, to ensure instant blowing of LT fuses whenever DT develops fault or conductor snaps.
- One earth megger should be provided in each sub station to ensure the prescribed / combined earth value to ensure safety especially in case of equipment fault.
- The AEE/O&M must inspect all sections at least once a month and review the safety class conducted register and pre monsoon inspection register.
- The AEE/O&M must ensure that all field staff of section covered in the subdivision are provided with PPE, earth rods, Torch lights, Raincoats etc.
- The AEE/O&M must ensure that all required safety appliances, ropes, adequate number of long size earth rods to earth all 22/11 KV feeders during shutdown of SS, ladders, torch lights, raincoats etc. are available in all substations in the jurisdiction of the subdivision.
- The AEE/O&M must ensure that no neutral mixing point, double source meeting point , street light mixing point, common service of street light for street lights on

either side of the DT etc. exist in the sub divisional jurisdiction to avoid scope for accident.

### **Section level:**

- The Section Officer has to ensure that safety is strictly followed without compromise while carrying out work in the field. Any unsafe act or unsafe condition must be seriously viewed by him and suitable corrective measures must be taken then and there.
- The Section Officer / O&M is responsible for implementation of safety in his section
- The LC on HT line must be availed only after getting approval from competent authority.
- Works on the HT feeders other than breakdown of feeders must not be carried out during holidays, unless emergency duly approved by the competent authority.
- Section officers must replace the damaged/corroded pole on a regular basis and ensure a safe condition that no damaged/corroded pole exists in the section.
- No all aluminium / aged conductors shall exist in the section. All such dangerous locations must be identified and the unsafe conductors must be replaced on priority.
- Section officers must ensure that no unsafe condition such as neutral mixing, street light wire mixing, crossing of DT structure by street light wire, leaned pole, stay cut locations etc. exist in the section. All such unsafe conditions must be converted in to safe condition, by prompt actions of the section officers.
- In every safety class, the section officer must review the identification of unsafe conditions, action plan etc. with free discussion with staff.
- The section officers must ensure adequate quantity of required size fuse wire to be provided in the DTs to ensure with fuse-below in case of conductor snapping accidents, or during any fault on the network to save human lives.
- Any change in network either HT or LT the details of such change should be recorded in the daily job allocation register and got signed by all staff as an acknowledgement to have known and understood such changes to take adequate precautions for safe working.
- Section officers must ensure availability of PPEs to all staff of the section and ensure their effective usage during work.
- Section officers must issue a warning notice to the consumer, whenever unsafe condition is noticed in the premises or come to his/her knowledge.
- In the normal working hours, any field work must be assigned only with the knowledge of the concerned Foreman / Lineman. This is to ensure that they are aware of the works that is going in the section and adequate safety measures are followed by them.
- Daily Work allocation must be assigned with clear entry in the job allocation register with all details.
- Job allocation must be specific with location/ consumer s/c no, feeder name, DT name etc.
- Reasonable time must be given for a job to be completed.
- To the extent possible employee shall not be permitted to attend multiple shifts in a day especially in fieldwork.
- The Section Officer / O&M must conduct safety awareness program every month without fail to impart proper safety training and create safety awareness among



the employees.

- A Safety Class register must be maintained and signature from all the employees who have attended must be obtained in the register. A group photograph in a normal mobile phone can be taken and a black and white / colour printout of the photograph has to be pasted in that register as proof for attendance.
- During this safety programme, all the employees must be directed to attend with their PPEs. The healthiness of PPEs available with the field staff shall be checked and action may be taken to replace the defective ones.

### **Responsibilities of Foreman / Line Inspector at Section Office :**

- The Foreman (Foreman, Foreman I Grade, Foreman Special Grade) and Line Inspector are responsible for implementation of safety in that section office and they must ensure that the workers follow safety instructions and procedures in each and every job they are taking up.
- They must assign a job to a worker taking in to account of their ability and capacity
- They shall exercise adequate and careful supervision over the workmen at all times. They must not leave the work spot, until the work is completed in all respects and supply is resumed.
- They must ensure that the worker always carry safety equipments with them and use them in all the work that they are carrying out.
- They must ensure that safety procedures are followed while working.
- They must avail Line Clears (LC) if required for a job and ensure all safety precautions being followed while obtaining LC. The LC must be properly closed by them after completion of work.
- They shall follow up the work with the workmen, to ensure that they are approaching the correct location of work and the circuit is isolated.
- Any near miss while carrying out work must also be reported to the Section Officer and possible steps must be taken to avoid it in future.
- They must report the unsafe conditions like corroded/leaned poles, low sag etc. to the section officer in writing.
- They are responsible for line patrol of pole to pole in all the HT/LT locations, record the pole wise/location wise the safe /unsafe conditions of each locations and hand it over to the section officer to alert and to convert the unsafe locations in to safe location.
- They must set right the loose sag locations.

- They must straighten the leaned poles.
- They must set right all the stay cut locations.

**Lapse in Safety :**

- Any lapse in safety noticed by concerned officer must be viewed seriously.
- Action deemed fit as per standing instruction / Service Regulation has to be initiated against the erring individual without fail.
- Action against any employee who is intoxicated with alcohol during his duty hours must be taken without fail.

## **CHAPTER – 3**

### **ELECTRICAL PERSONAL PROTECTIVE EQUIPMENTS & TOOLS**

Electrical Personal Protective Equipment (PPE) are equipment designed to protect workers from electrical hazards while working on electrical equipment and construction sites. Employees who work in construction / Operation & Maintenance of Sub stations, lines, power stations, machines and equipments etc. must be provided with appropriate electrical PPE and be knowledgeable in the selection, use, limitations, inspection and maintenance of PPE.

Every employee must be ensured that he is provided with proper PPE and also he/she uses it while working to ensure his/her safety and the safety of co-workers. A register must be maintained in the Section offices for issue of PPE by the officer in charge for the work.

The following are the minimum requirement of safety devices & specific tools / Personal Protective Equipments having ISI mark that has to be provided.

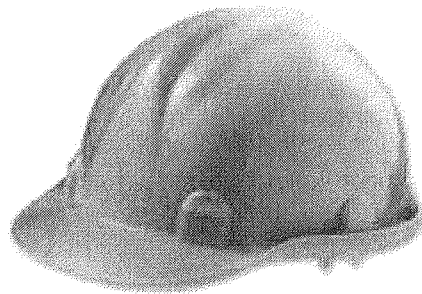
- Helmet
- Goggles and Eye Shields.
- Rubber Hand Gloves
- Safety Belt ropes
- Protective Clothing
- Safety Shoes
- Safety Footwear
- First grade nylon Rain Coat
- Discharge Rod
- Earth Rod
- Gaunlets
- Voltage detector
- Hand tools
- Non-conductive ladder

## Helmet :

To effectively reduce the risks of head injury, an appropriate type of safety helmets should be provided. Helmet is required in the work places

- where there is a possibility that a worker may be struck on his head by a falling or flying object;
- Where a worker may strike his head against a protruded object or may be struck by a swinging object.

The safety helmet selected should satisfy certain performance requirements including shock absorption, resistance to penetration; and be adjustable to fit and make comfortable to the user. Certainly, the safety helmet can never be effective unless it is properly worn for the purpose.



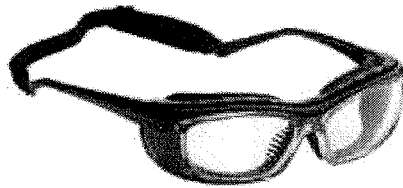
Helmet of good quality should be required for tasks that can cause any force or object falling to the head. When performing head protection safety checks, ensure that there are no dents or deformities on the shell and connections are tightened inside. Do not store in direct sunlight and always replace a hard hat if it was used for any kind of impact, even if damage is unnoticeable.

Safety helmets should satisfy certain performance/test requirements, including resistance to penetration, shock absorption, electrical insulation, resistance to flame and various working temperature, etc. Each design should have its own specifications to suit the working environment and the work to be done. A suitable safety helmet will mean one which is conforming to **Indian Standard 2925: - Specification for Industrial Safety Helmets**

## Face and Eye Protection

PPE includes safety goggles and face shields and should be used for tasks that can cause loss of vision and an eye, burns, splashes, sprays of toxic liquids etc. Goggles or eye shields should be worn while performing the following operations:

- Welding and burning:
- Using grinders, jackhammers, pneumatic tools, chisels, shapers and drills;
- Painting and scraping
- Brushing or blowing machines for cleaning;
- Operating switches on load.
- Handling acids, strong alkalis in the battery room.



When conducting equipment safety checks, ensure that there are no cracks or deformities on the lenses, ensure the strap is in good working order and is firmly sealed to the cheek and forehead. A Safety goggles should conform to the **Indian Standard 5983** : - **Specification for Eye Protectors.**

## Hands Protection

Rubber gloves that have been tested to atleast 10,000 volts should be worn when work is performed on, or within reach of, energized conductor and/or equipment. The rubber gloves should be available to all employees working in substation operations and maintenance and field staffs working on HT/LT lines, Distribution transformer etc.



The specification PPE includes safety gloves and should be used for while operating AB Switches and other tasks that can cause hand and skin burns, absorption of harmful substances, cuts, fractures or amputations. When inspecting hand protection equipment, ensure that they fit perfectly with no spaces and are free from cuts, burns and chemical residue. Always replace them if any sign of contamination was observed.

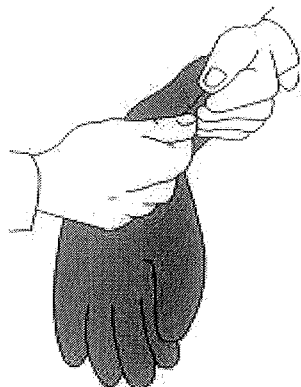
### Inspection of Rubber Gloves

Before rubber gloves are used, a visual inspection and an air test should be made. Inspection is required to be done daily prior to use and as many times during the day of use you feel necessary.

#### Visual Inspection

When inspecting rubber gloves, stretch a small area at a time, as shown in Figure checking to see that no defects exist, such as:

- Embedded foreign material
- Deep scratches
- Pin holes or punctures
- Snags or cuts
- Unusual discoloration
- Burns

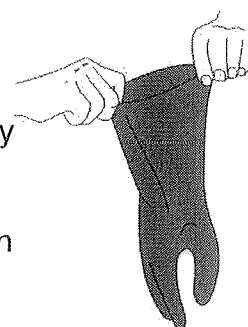


Look for signs of deterioration from age such as hardening and slight cracking. Also, if the glove has been exposed to petroleum products, it should be considered suspect because of the deterioration caused by exposure. Gloves that are found defective should be replaced. Never leave a damaged glove around for any other purpose; someone may think it is a good glove and not perform an inspection prior to using it.

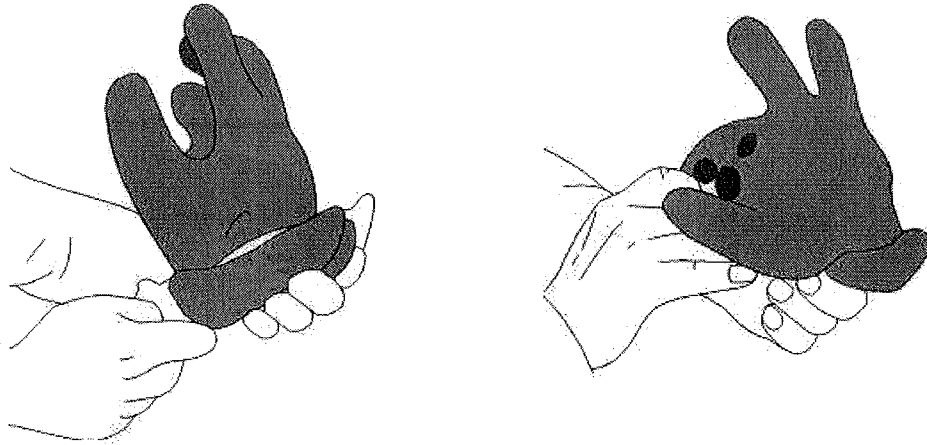
#### Air Test

After visually inspecting the glove, other defects may be observed by applying the air test as follows:

1. Hold the glove with thumbs and forefingers, as shown in Figure.



2. Twirl the glove around quickly, or roll down from the glove gauntlet, as shown in Figure below.



3. Trap the air by squeezing the gauntlet with one hand. Use the other hand to squeeze the palm, fingers, and thumb in, looking for weaknesses and defects, as shown in Figure above.
4. Hold the glove up to your face and ears to try and detect any escaping air.
5. If the glove does not pass this inspection, it should be destroyed and replaced.

#### **Maintenance of Gloves:**

- Gloves / Gauntlet has to be tested for its insulation resistance, in an electrical laboratory at an interval not exceeding six months in accordance with Indian Standard –4770/1991.
- Rubber equipment shall not be folded or allowed to come in contact with sharp objects.
- Rubber equipment shall not be exposed to oil or grease or sun when not in use.
- Rubber equipment shall be kept clean. French chalk shall be used as preservative for storage of safety gloves.
- Rubber deteriorates under high temperatures. As such it is preferable to store rubber equipment in cooler places after drying when wet.
- Rubber equipment shall not be stored near batteries or acid stores and near live apparatus, i.e., where ionization or corona may be present, as this causes rapid deterioration of rubber.

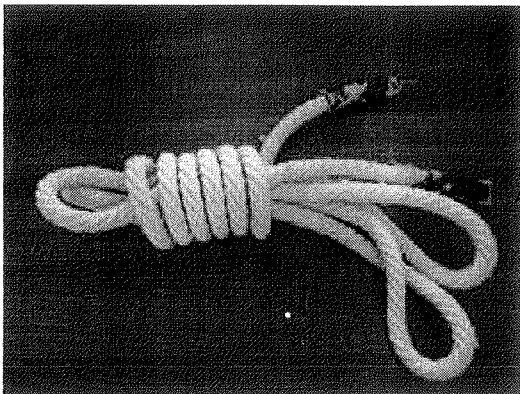
#### **Safety Belt Ropes**

Safety Belts (Cotton rope – ¾” dia, 6m length) should invariably be used in all cases while working on overhead systems, above two meters, like HT/LT lines, Structures, sub-station works etc. The belts may be equipped with leather straps or pockets for carriage of tools.

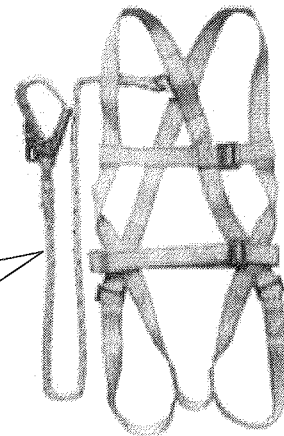
Chains and wire hooks shall not be used for this purpose.

The following procedure shall be observed for inspection and maintenance of Safety harness:

- No changes and alterations (including punching of extra holes) shall be done.
- Belts and straps shall not be dropped or thrown from an elevation.
- Belts and straps shall not be exposed to heat. These belts shall be kept out of range from blow torches, furnaces and other sources of heat or sharp objects.
- Belts and straps should not be allowed to come in contact with sharp objects, batteries and acids.
- Belts and straps shall be wiped with clean rag after work in rain and then allowed to dry at room temperature and periodically treated with castor oil to prevent it from becoming hard.
- Employees using the safety belts shall be fully conversant with proper and correct method of wearing and removing of belt.
- Safety Belt should be checked for its wear and tear before and after each use.
- Safety Belt should not be used after its recommended use period as mentioned by the supplier.



Safety belt that is to be used while working in HT / LT Poles

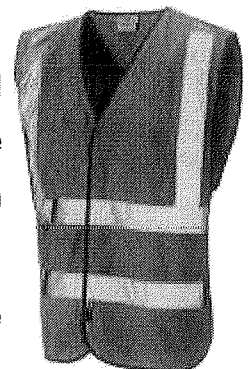


Safety harness that is to be used working in heights

### Protective Clothing

An individual who is going to be working in a substation should dress accordingly. The wearing of synthetic fiber clothing should be avoided. These types of materials tend to melt when exposed to high temperatures and will actually increase the severity of a burn.

Cotton clothing is appropriate type of clothing. Employees who are working in public roads must wear reflective protective jackets

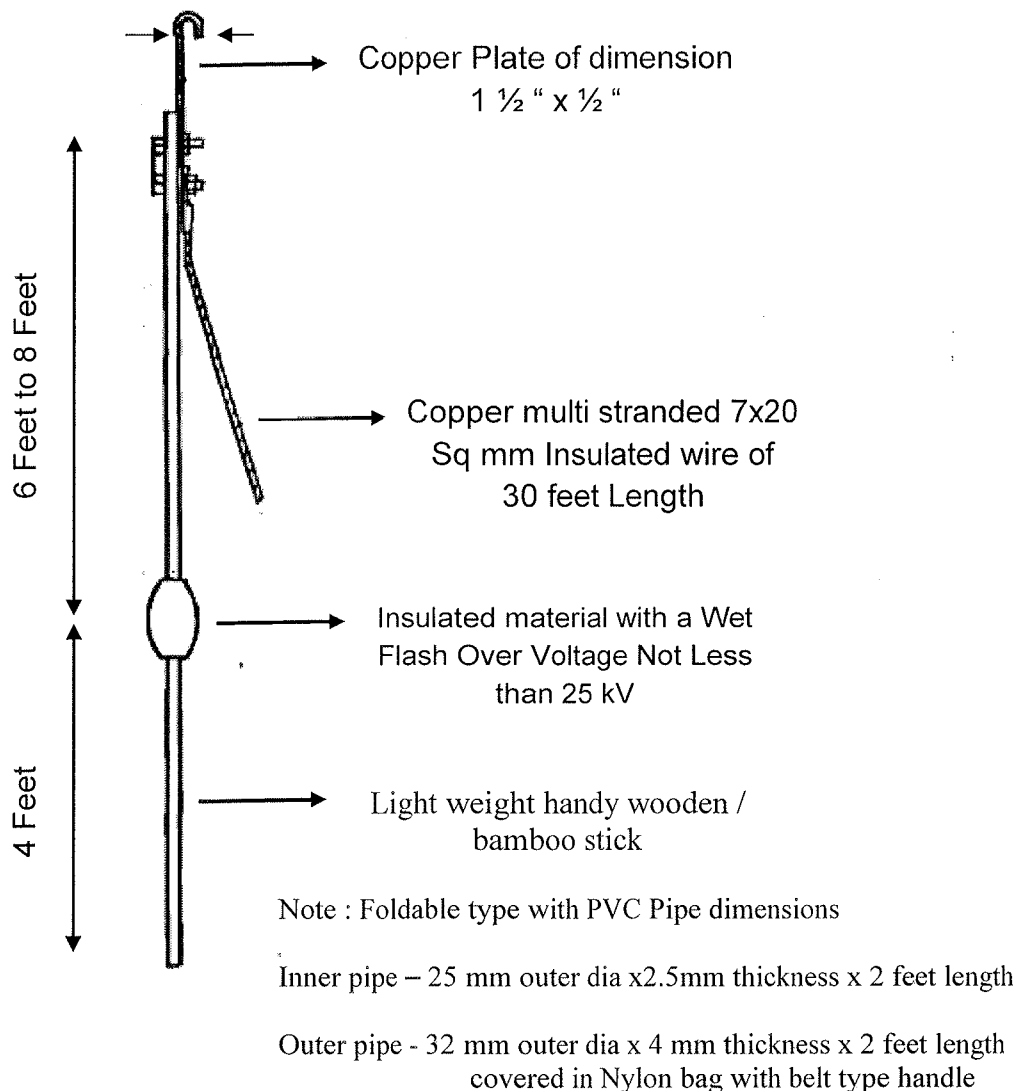




## Foot Protection

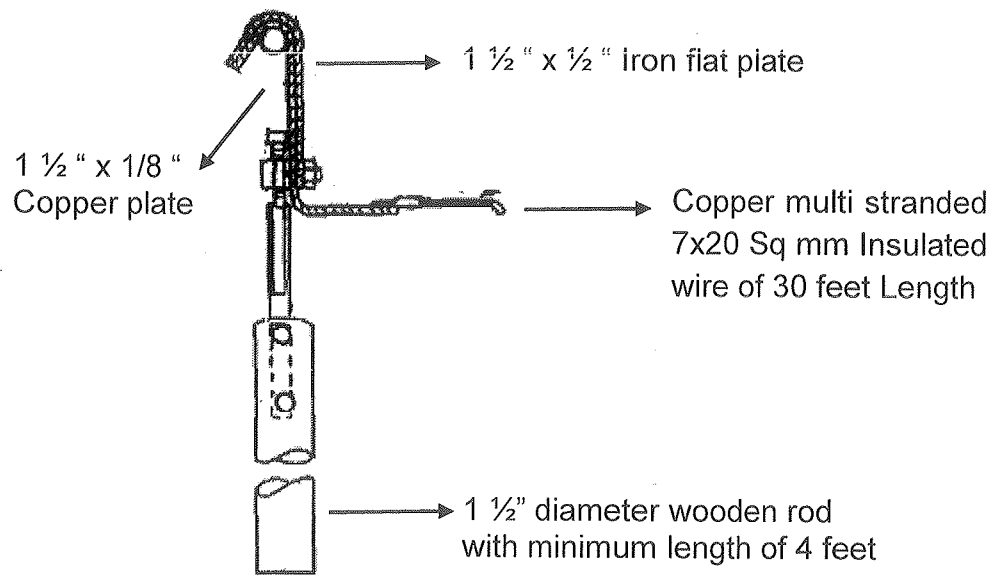
Safety boots should be used for tasks that can cause serious foot and leg injuries from falling or rolling objects, hot substances, electrical hazards and slippery surfaces. Use boots with slip-resistant soles that protect against compression and impact.

## Discharge Rod



- The discharge rod shown above must be readily available in all sub stations and with the team working with HT lines.
- The discharge rod shall be used to discharge the stagnant electric charge in a deenergised line, before commencement of any works.

## Earth Rod



Note : Foldable type with PVC Pipe dimensions

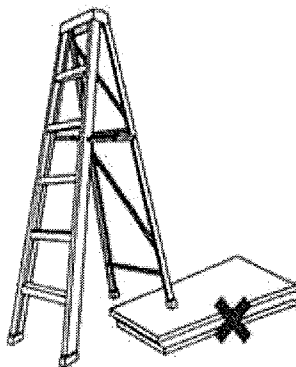
Inner pipe – 25 mm outer dia x 2.5mm thickness x 2 feet length

Outer pipe - 32 mm outer dia x 4 mm thickness x 2 feet length  
covered in Nylon bag with belt type handle

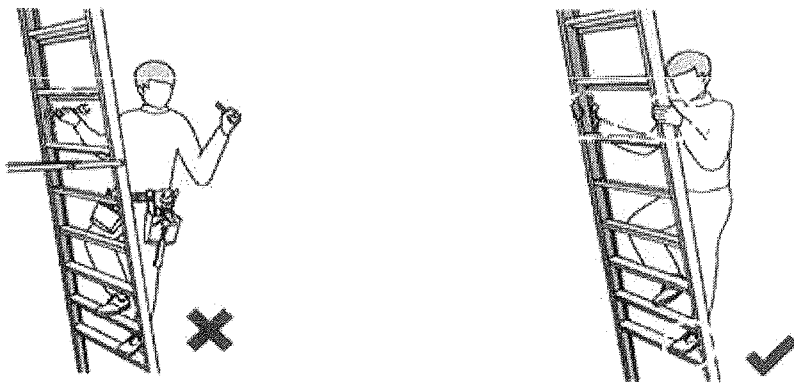
- The earth rod shown above is an important protective tool which must be properly used before commencement of any line work.
- The proper method of usage of Earth rod is detailed in chapter 11 of this manual.
- Each and every field worker must ensure that before proceeding to any field work he carries with him a set of three well maintained earth rods.
- The earth rod wires must not have any joints and the wire has to be handled properly while carrying and storing to prevent damage to the insulation of the wire.
- A Physical examination of the wire has to be often conducted often to ensure that the insulation is in good condition.

### Ladders

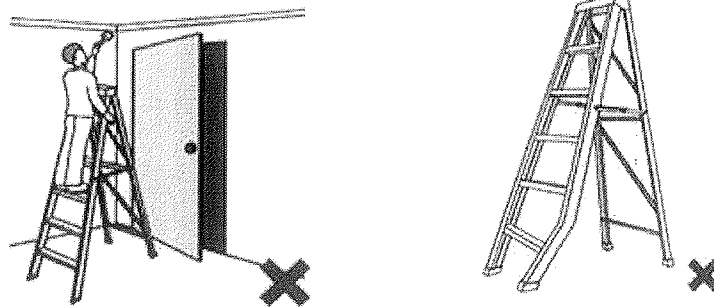
- All portable ladders shall be equipped with non-slip bases and care shall be exercised in placing and blocking or lashing or having the ladder held by someone especially upon oily, metal or concrete surfaces.
- The bottom of the ladder shall not be kept away from the wall more than one fourth of the length of the ladder.
- Ladders should not be placed on an uneven surface or on any table, barrels etc. it must be placed on flat non slippery ground only.



- While going up or down a ladder, always face the ladder and use both hands. A three point contact with the ladder has to be made. Also it must be ensured that while climbing up / down the ladder no tools must be carried in hand /pockets.



Ladders shall not be placed in front of doors or windows opening towards the ladder, unless doors or windows are locked.



- Ladders, when fallen or struck, shall be carefully inspected for possible damage, ladders with weaken, broken or missing steps or otherwise defective, shall not be used.
- Wooden ladders for outdoor use shall be given a suitable coating of clear varnish or linseed oil or bituminous paint. Metallic paint shall not be used in wooden ladders.
- Portable ladders shall not be used in sub-station or switching station containing exposed high voltage conductor without the authority of authorized person. All portable ladders when used in a sub-station shall be locked to suitable anchorage when not in use. Portable ladders shall not be used in the vicinity of live parts.

### Hand Tools

- Employees shall use the right tools for each job and tools. The tools which developed defects while in use, shall not be used until the defects have been rectified.
- Keep the tools in good condition with regular maintenance.

- Hammers with half broken or damaged handle must not be used. The handles must be replaced and maintained properly.
- Screw drivers should not be used as a chisel.
- When working on LT network or near live LT network long screw drivers without insulation or pliers with damaged insulation should not be used.
- Tools must be properly stored when not in use and not to be kept scattered all-around.
- Portable electric tools shall be equipped with 3-wire cord having the ground wire permanently connected to the tool frame and means for grounding the other end. Portable hand lamps shall be equipped with proper guards. The lamp holder shall not be in metallic contact with the handle and the guard.
- The extension cords shall not be dragged over sharp or rough surfaces or subjected to pressure by passing vehicles or material over them.
- Pliers, wrenches, etc., whether insulated or not, shall not be used without rubber gloves while working near live parts.
- Metal measuring taps and rules and tapes having metal threads woven in them shall not be used in the vicinity of live apparatus.
- Impact tools such as, chisels, punches, hammers and wedges with mushroomed heads shall not be used.
- Axes, shovels and similar tools shall not be used if handles are loose, cracked or splintered.
- Defective open and adjustable wrenches with spread jaws or pipe wrenches with dull teeth shall not be used.
- Pipe or other extensions shall not be used on wrench handles to increase the leverage unless the wrenches are specifically designed for such end extension.
- Only competent persons shall be allowed to handle blowtorches and firepots.

## CHAPTER - 4

### SAFETY IN DISTRIBUTION CONSTRUCTION WORK

This chapter deals with the general safety conditions that have to be followed while carrying out construction / erection activity of the following.

- 33/22/11 kV Substation and its associated equipment
- Distribution Transformer structure
- Overhead HT / LT Lines
- Underground HT / LT Cable

#### GENERAL SAFETY REQUIREMENTS :

Only good quality and materials as per BIS/IS specifications, having more than adequate mechanical strength and the desired factor of safety for the supports and conductors as mentioned in the Safety Regulations, for construction of transmission lines and substations, must be used.

Implementing Standard practice of Construction eliminates unsafe condition, avoid danger and ensure safety. The following are statutory requirements mandated by the Regulation :-

- Regulation 12 of Central Electricity Authority (**Measures relating to Safety and Electric Supply**) Regulation 2010, General Safety requirements pertaining to construction, installation, protection, operation and maintenance of electric supply lines and apparatus:
  1. All electric supply lines and apparatus shall be of sufficient rating for power, insulation and estimated fault current and of sufficient mechanical strength, for the duty which they may be required to perform under the environmental conditions of installation and shall be constructed, installed, protected, worked and maintained in such a manner as to ensure safety of human being, animals and property.
  2. Save as otherwise provided in these regulations, the relevant Indian Standards or National Electrical Code, shall be followed to carry out the purposes of these regulations and where relevant Indian Standards are not available, International Standards shall be followed and in the event of any inconsistency, the provision of these regulations shall prevail.
  3. The material and apparatus used shall conform to the relevant specification of the Indian Standards or National Electric Code or International Standards where such specifications have already been laid down, and where relevant Indian Standards are not available.
  4. All electrical equipment shall be installed *above* the Mean Sea level(MSL) as declared by Local Municipal Authorities and where such equipment is to be installed in the basement, consumer shall ensure that the design of the basement should be such that there is no seepage or leakage or logging of water in the basement and shall ensure compliances of these regulations..

- **Safety Requirements for Over head lines, Under ground cables and Generating Stations**

**Material and strength** : Regulation 55 of CEA(measures relating to Safety and Electric Supply) Regulation,2010

1. All conductors of overhead lines other than those specified in regulation 68 shall *have* a breaking strength of not less than 350kg.
2. Where the voltage does not exceed 250 V and the span is of less than fifteen meters and is drawn through the owners or consumer premises, a conductor having an actual breaking strength of not less than 150 Kg may be used.

- **Joints, Regulation 56 of CEA(measures relating to Safety and Electric Supply) Regulation,2010**

- 1) a) No conductor of an overhead Line shall have more than one joint in a span and joints between conductors of overhead lines shall be mechanically and electrically secure under the conditions of operation.  
b) There shall not be any joint in conductor or earth wire of an overhead line over railway, metro track, river, highway and power line crossings
- 2) The ultimate strength and the electrical conductivity of the joint shall be as per relevant Indian standards or International Standards, where relevant Indian Standards are not available.

- **Maximum stresses, factors of safety, Regulation 57 of CEA(measures relating to Safety and Electric Supply)Regulation,2010**

- 1) The load and permissible stresses on the structural members, conductors and ground wire of self-supporting steel lattice tower for overhead transmission lines shall be as per relevant Indian Standards or International Standards, where relevant Indian Standards are not available
- 2) Overhead lines not covered in sub-regulation(i) shall have the following minimum factors of safety, as per the table given below :-

Description	Minimum factors of safety
Metal Supports	1.5
Mechanically processed concrete supports	2.0
Hand molded concrete supports	2.5
Wood Supports	3.0
Steel mono pole, Self Supporting	2.5

- **Conductors at different voltages on same supports" Regulation 62 of CEA (measures**

relating to Safety and Electric Supply)Regulation,2010

Where conductors forming parts of systems at different voltage levels are erected on the same support, the owner shall make adequate provision to guard against danger to linemen and others from the lower voltage system being charged above its normal working voltage, by leakage or contact with the higher voltage system and the methods of construction and the applicable minimum clearances between the conductors of the two systems shall be as specified in regulation 69 for lines crossing each other.

Note :- Refer Chapter9 on this manual for standard clearances

- Routes -proximity to aerodromes, Regulation 66 of EA (measures relating to Safety and Electric Supply) Regulation,2010

Over-headlines shall not be erected in the vicinity of aerodromes unless the Airport Authorities have approved in writing the route of the proposed lines as per relevant Indian Standards.

- Maximum intervals between supports, Regulation 67 of CEA (measures relating to Safety and Electric Supply) Regulation,2010

All conductors shall be attached to supports ,at intervals not exceeding the safe limits based on the ultimate tensile strength of the conductor and the factor of safety specified under regulations 57.

Provided that in the case of over-headlines carrying conductors of voltage not exceeding 650 V when erected in over, along or across any street the interval **shall not** without the consent in writing of the Electrical Inspector **exceed 65 meters.**

- Condition to apply where telecommunication lines and 'Power lines are carried on same supports, Regulation 68 of CEA (measures relating to Safety and Electric Supply)Regulation,2010

i) Every overhead telecommunication line erected on supports carrying a power line shall consist of conductors each having a breaking strength of not less than 270 kg.

ii. Every telephone used on a telecommunication line erected on supports carrying a power line shall be suitably guarded against lightning and shall be provided by Cut-outs.

iii) Where a telecommunication line is erected on supports carrying a power line of voltage exceeding 650 V, arrangement shall be made to safeguard any person against injury resulting from contact, leakage or induction between such power and telecommunication lines.

- Lines crossing or approaching each other and lines crossing street and road,



**Regulation 69 of CEA (measures relating to Safety and Electric Supply) Regulation,2010**

Where an over-head line crosses or is in proximity to any telecommunication line, the owner of either the over-head line or the telecommunication line, whoever lays his line later, shall arrange to provide protective devices or guarding arrangement and shall observe the following provisions, namely:

i. when it is intended to erect a telecommunication line or an over-head line which will cross or be in proximity to an over-head line or a telecommunication line, as the case may be, the person proposing to erect such line shall give one month notice of his intention so to do along with the relevant details of protection and drawings to the owner of the existing line.

ii. guarding shall be provided where lines of voltage not exceeding 33 kV across a road or street.

iii. where an over-head line crosses or is in proximity to another overheads line, guarding arrangement shall be provided so as to guard against the possibility of coming into contact with each other.

iv. where an over-head line crosses another over-head line, clearances shall be as under:

(Minimum clearance in meters between lines crossing each other).

Sl. No	Nominal System Voltage	11- 66 kV	110 - 132 kV	220 kV	400 kV	800 kV
1.	Low and Medium	2.44	3.05	4.58	5.49	7.94
2.	11-66 kV	2.44	3.05	4.58	5.49	7.94

provided that no guarding are required when line of voltage exceeding 33 kV crosses over another line of 250 V and above or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the line of voltage exceeding 33KV and the top most conductor of the overhead line crossing underneath the line of voltage exceeding 33KV and the clearances as stipulated in regulation 58 from the topmost surface of the road maintained.

**Precautions to be taken while making preparatory works for erection such as ground leveling works, excavations etc..**

- Before taking up the work for preparation, It shall be ensured that the place selected is free from any UG cables, water pipe lines, Earthing pipes, Oil / Gas/ Chemical pipe lines.
- Rocky places may as far as possible be avoided.
- Under un avoidable circumstances, if any rocky area is selected and usage of explosives are warranted, suitable safety measures as prescribed may be adhered

**Following Standard erection practices / Safety norms shall be adhered :-**

1. HT and LT bushings of the DT should be connected only through bushing clamps.
2. All metal parts of HT poles must be earthed with 8 SWG GI wire to the earthing coil.
3. Every fifth pole in LT line must be made as cut point, concreted and earthed.
4. If the pole is of Metal one all the poles shall be earthed effectively.
5. Thimble should be used in stay set to avoid cutting of strands of stay wire.
6. All metal parts used in the current carrying path must be of G.I.
7. Earth pipe must be below the ground level by 200 mm
8. Guy insulator should be erected above 3 meters from ground as per regulation 72(3)
9. U shaped jumpers should be erected in all jumpers, tapping points to avoid snapping of conductor.
11. All HT lines and LT lines must be provided with guarding to avoid accident due to snapping of conductors as per regulation 13 (i).
12. All guarding wires must be earthed on both sides of its termination as per regulation 70 (1)
13. All outdoor sub stations (DT yard) to be efficiently protected by fencing not less than 1.8 m in height as per regulation 49.

14. The neutral wire from one DT to another DT should not be linked. Street light wire from one DT to another DT should not be linked. There should be dummy line between adjacent DTs with cut points for phase, neutral and street light wire on either ends of dummy span.

15. In case of 3 phase 5 wire line the wire running on TI fitting to be allotted for street light wire.

16. The HT/LT running on same support should be of same HT sources.

17. In all multilayer circuits running on same support, guarding should be provided under every circuit.

18. Street light boxes, pillar boxes must be kept closed and locked as per regulation 23 (4)

19. Every DT structure must be erected with 4 wire 7/4.09 ACSR bus bars.

20. Single pole DT must be erected only with square pole 150 Kgs.

21. Double pole DT structures should be erected only with 9m 400 Kg. PSC Poles.

22. Cut points and tapping points must be provided with metal parts for stringing the line. No line should be tied with pole by GI Wire.

23. In specific locations where bird faults is recurrent, higher size of cross arms with increased phase to phase clearance or double tier arrangement with two number cross arms may be used.

### **EXPLOSIVES: Storage, Transportation, Handling & Use**

- All explosives shall be stored in dry condition in a waterproof permanent godown.
- The godowns shall be locked intact prohibiting entry of any un authorized person.
- A warning notice(with warning sign (**EXPLOSIVE- KEEP AWAY, DANGER**)) shall be displayed in a conspicuous place

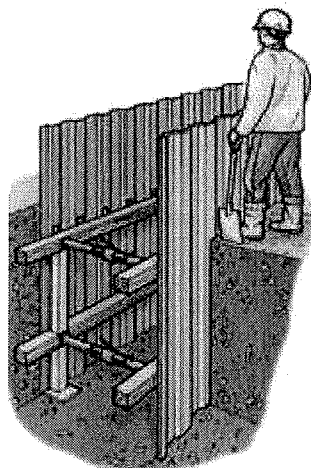


- The Explosives shall be transported through a vehicle of sufficient cushion through springs such that it will not subject to jerk and friction and the speed of the vehicles shall not exceed 25KMPH.
- Before drilling holes for filling the gap with explosives, it shall be ensured that no explosives are available in the existing holes and it shall also be ensured that all the explosives were exploded.
- After filling the explosives in the holes no drilling shall be done in the near by areas.
- A warning / caution shall be made to the public who are in access to the explosive area to stay away from such place to a safe distance.
- After explosion, the loosened soil / rocks shall be carefully removed away from there and persons engaged in the above work shall wear, protected shoes, helmets and life line rope etc.
- Detonators for exploding dynamite are of two kinds... (Hose ignited by fuse known as blasting cap; those fired by electric current are known as electric blasting Caps.
- Only person who are qualified by training and experience shall be permitted to handle, use or transport explosives.
- Dynamite and caps shall be stored in separate containers duly marked. While transporting dynamite and caps shall be placed in separate locked containers such containers will be kept as far apart as possible but not less than 3fts.(100cm.)
- All surplus explosive shall be returned to magazines as soon as possible following completion of a job.
- The area within 28th feet (9Mtrs) radius of Magazine shall be kept free of flammable debris and magazines floors shall be kept clear.
- Smoking and open flames are prohibited within 50 feet (15Mtrs) of any magazine or explosive.

- Trucks carrying explosives must not be left parked in congested areas, or subjected to major repairs.
- Smoking and open flames are strictly prohibited within 50 feet of explosives.
- Explosives, either in containers or otherwise shall not be thrown from trucks, slide along floors or handled roughly in any manner.
- Do not keep the explosives exposed to direct rays of the sun for a longtime.
- Do not leave dynamite, lighting, explosives and caps unguarded.
- During approach and progress of a lightning storm, all handling and use of explosives shall he stopped and all authorized line staff shall seek a place of safety.
- Do not leave explosives empty cases or lining papers lying around where they *are* accessible to *livestock*, since animals may eat them and be poisoned.
- Deteriorated *explosives* should be destroyed by methods recommended by the manufacturer. They should neither be thrown into streams or bodies of water, nor buried in the ground.

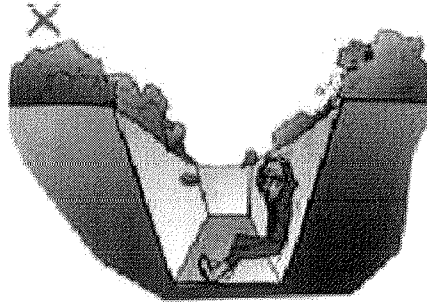
### EXCAVATIONS

1. Proper and adequate timber shoring and bracing shall be provided to prevent sliding or slipping of loose or unstable earth, rock or other material or caving in of excavation.



2. Under cutting of banks of trenches and other excavations shall be avoided.

3. Excavated material shall be dumped away from the edge of the *excavated* trench to avoid the slipping of excavation material into the trench.



4. Excavation shall be properly fenced to protect men and animals from falling in.
5. Warning sign shall be placed near the excavation to warn the approaching traffic and men. At night, red danger light shall be displayed at a conspicuous point near the excavation.

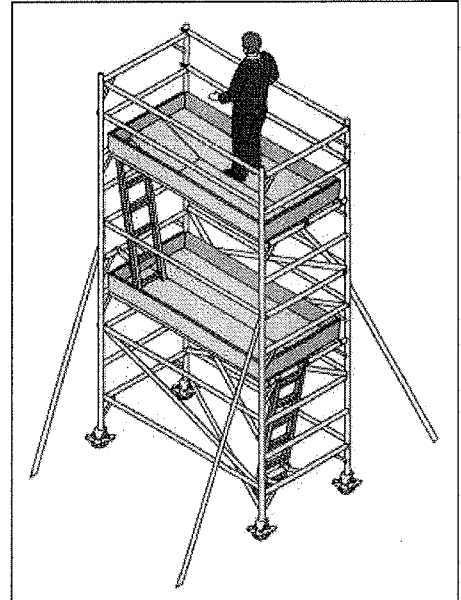


6. The following additional safety measures to be adopted while working in a sloppy terrain

- All work shall be done under the supervision of an experienced person.
- Loose soil / rock shall be removed then and there frequently.
- No person shall be allowed to work on a height above the workingperson.
- The person working on such places shall use life line waist belt rope and safety helmet compulsorily.
- If the pits are above 6 feet depth and easily accessible, then a barricade of height 2 feet shall be provided close to it.
- The trenches dug on the public places / places of easy approach shall be barricaded with Fluorescent DANGER Tape.

## SCAFFOLDING

- Scaffolding shall be carried out with wood of no defect and no notches.
- All scaffoldings shall be provided with adequate supports at appropriate locations.
- Trestle scaffolds shall not be more than 3 tiers and its working platform shall not be more than 15 feet height.
- Care must be exercised during dismantling of scaffolding and no objects shall be thrown down.
- If the working height is more than 5 feet, then it shall be provided with a ladder or stair. This shall be provided for each tier.
- If the scaffolding is for a long duration, then stairs made of wood and hand rails on both sides shall also be provided.



## CONCRETING AND CEMENTING

- If working at a height, the workers should use life lines or safety belts.
- Workers handling cement or concrete shall protect themselves by wearing rubber boots and rubber gloves as required.
- Proper guards and covers shall be provided on mixer gears, chains and rollers.

## WELDING, BURNING, CUTTING (GENERAL)

1. The primary hazards encountered during welding are Electric shock. Burns, radiant energy, toxic fumes, fire and explosions.

2. Avoid burns from electric arcs, gas welding flames, hot slag or touching welded parts before they become cool by the following precautions:

- Suitable goggles or welding helmets, safety welding gloves shall be worn for protection while welding. Barriers should be erected to protect other authorized

line staff from rays of electric arcs or welding flames. Ultraviolet, infra-red and excessively bright visible light rays are injurious to eye.

- While doing welding works in structures / steel poles in line, it shall be ensured that no other persons are in physical contact with the structure / pole in which the welding works are to be carried out.



- Clean goggles should be worn while chipping the slag.
  - Adequate ventilation shall be provided while welding in confined spaces or while brazing cutting or welding zinc, brass, bronze, galvanized or lead coated material. Poisonous fumes may be generated during the welding process by metallic oxides, coatings on the materials being cut or welded, or by the electrode or flux rod.
  - While welding or cutting in elevated position, precautions should be taken to prevent sparks or hot metal falling on to people or inflammable materials.
  - Welding or cutting should not be attempted in dusty or gaseous areas where there is a danger of causing explosion.
  - Before welding or cutting a pipe, tank or container that has held flammable materials, drain it thoroughly out and fill the container with water or thoroughly wash the container with a caustic solution and spray sufficient carbon-tetrachloride into the container to fill it with non-explosive vapour.
3. Authorized line staff should avoid contact with the electrode or other live parts of electric welding equipments. Alternating currents (AC) are dangerous even at low voltage.
  4. In acetylene burning and welding, never allow oil or grease to come in contact with any cylinder, regulator, connection of gas welding equipment. Oil or grease in the presence of oxygen may cause a violent explosion.
  5. Never use matches to light a blow pipe. Use a friction lighter, stationary, pilot

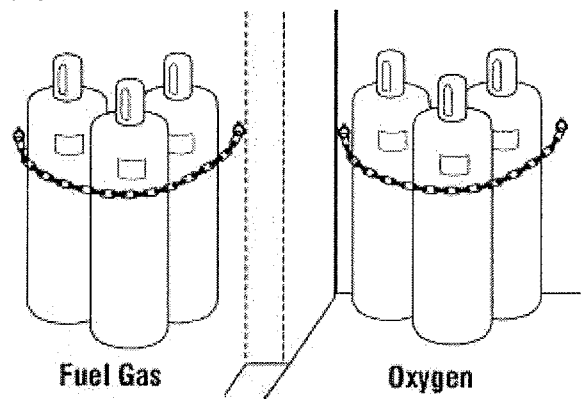


flame or other suitable source of ignition.

6. All the welding cables shall be tested for insulation conditions periodically.

### **HANDLING AND STORING COMPRESSED GASES**

1. Cylinders containing acetylene, Oxygen, chlorine, hydrogen, Nitrogen, Carbon dioxide etc, should be stored upright in approved safe places where they cannot be knocked over and well separated from radiators, furnaces and combustible material.
2. Oxygen cylinders should be isolated from acetylene cylinders and gas filled cylinders separated from empty ones.



3. Gas cylinder should be protected from direct rays of the sun.
4. Empty cylinders should be plainly marked EMPTY and the valves closed.
5. Gases like Carbon dioxide, Chlorine have a tendency to settle down when released in air. They also diffuse very slowly. Therefore when working in manholes and basements, care must be taken to see that an accidental leak will not lead to suffocation. In such locations the gas cylinders should be placed away from the manhole openings or entrances to basements.

### **TRANSPORTATION**

#### **GENERAL PRECAUTIONS**

1. Vehicles should be kept in good operating condition and the vehicle should be driven in a safe manner so as to prevent injury to the authorised line staff and others.
2. Unauthorised staff shall not operate a car or truck.
3. Every driver of the car, jeep, lorry or truck shall be thoroughly familiar and comply with the State and city traffic laws covering the territory where he operates.
4. Confirm that the RTO Passing is done for the vehicle.
5. Labour carrier certificate (5 yearly) approved by RTO should be available..

6. Insurance shall be available and shall be in force
6. The brakes, clutch, horn and lights must be in good condition.
7. It should be confirmed that tyres are in good condition and properly inflated. The air pressure shall be maintained in such a way that it is neither excess nor low.
8. Emergency equipments such as first aid kits, jacks and tools, spare bulb for head lamps etc. must be available . Any equipment found missing or defective should be reported immediately.
9. Every driver shall report the vehicle's defect if any is detected.
10. Before filling the fuel tank, the engine of the vehicle should always be shut off. The hose nozzle should be kept in contact with the tank to avoid static sparks. Care shall be taken to avoid overflow / spilling of fuel from tank. While filling the petrol or diesel tank, smoking or using any open flame near the vehicle is prohibited and not allowed.
11. Cell Phones shall not be operated.

### DRIVING

1. Most traffic accident can be prevented by faithful observation of following rules:
  - a. 'Control speed', speeding is dangerous. A few minutes saved at the cost of an accident is no bargain, for a human life.
  - b. Avoid distractions. Give your undivided attentions to the job of driving. Keep your eyes on the road. Avoid mobile phones while driving.
  - c. Drive defensively. Don't insist on your right of way. Try to anticipate the intention of other drivers and pedestrians. Their failure to observe traffic regulations does not justify your running into them.
2. Follow traffic rules.
3. Keep safe distance from the vehicle in front
4. Don't drive vehicle without enough sleep in the previous nights.
5. Do not attempt to pass another vehicle going in the same direction unless you can plainly see far enough ahead to be sure you can pass safely. Proper horn signal should be given before passing.

6. Do not drive, when tired, deceased or under the influence of drugs.

7. Do not drive to the right of the road Centre when approaching the crest of a hill, an intersection, rail road crossing or curve where full view of the roadway ahead is obstructed.

### **PARKING**

1. Park on the proper site on the street close to the curb or of the high way so as not to interfere with traffic.

2. When parking along a highway at night, parking lights shall be left ON but dimmed. If any work is to be done flares shall be set at opposite ends to warn other drivers. Vehicle should not be parked in 'No PARKING' area.

3. When parking on a grade, place the vehicle in gear, set hand brake, turn wheels to curb or otherwise block the car so that it cannot accidentally roll.

4. To change a tyre or make other necessary repairs along the high way, pull over to the side of the road as far as possible.

5. Before leaving a parked vehicle, always remove the ignition key to prevent theft or unauthorized starting of the vehicle.

6. Leave or enter parked vehicle on the curb side wherever possible. Use extreme care if doors are on road side to see that no other vehicles are near.

7. Before starting a parked vehicle, observe front and rear to make sure that authorised line staff and objects are out of the way.

### **OPERATION OF TRUCKS AND TRAILERS.**

1. Before starting a truck, the man in charge of the team should carefully inspect the loading of material and see that wherever necessary, the material is secured safely and that all men are safely aboard.

2. Loadings of vehicles should not exceed their rated capacity and objects like poles should not be permitted to be extended beyond the sides unless the necessary permit has been obtained from the Authorities.

3. The strength of passengers carried in trucks should not exceed the legally permitted number

### **PROCEDURE IN TRAFFIC ACCIDENT**

1. Do not get involved in an argument as to who was responsible for an Accident, but endeavor to get all facts in the case. Remember that accidents which may appear trivial often result in claims for authorized Line staff injury or property damage.

2. Do not lose your temper; try to be courteous and helpful.

3. Following instructions should be observed in the order given, if possible, when you are involved in a traffic accident;

- a) STOP-Pullover to the curb or out of traffic, if possible. Never leave the scene of an accident without stopping to identify yourself and render such assistance as possible.
- b) If the accident victim got severe injuries and no vehicle is available for shifting him to the nearest Hospital, dial 108 or Highway emergency services for emergency ambulance service. If 108 ambulance is also not available or getting late to arrive, then arrange for a private vehicle to shift him to the nearest hospital for First Aid within 10 minutes which is the golden hour to save the life of the victim.
- c) Assist injured authorized line staff in so far as you are able, giving immediate attention to severe bleeding. Do not move seriously injured authorized line staff unless necessary for their protection against further injury. Send for doctor and ambulance, if necessary.
- d) When requested, give your name, address company affiliation and show driver's license to the other party.
- e) Secure name, address and license number of the other driver car license number and names and addresses of car owner and insurance company.
- f) Record names and address of witnesses.
- g) Unless some policeman is present at the scene of the accident, notify police having jurisdiction in the territory.
- h) Sketch the location showing position of vehicles or pedestrians involved and any special conditions such as obstructions, parked cars, skid marks, show date, time of day, weather and road conditions and any other information which you may consider useful.
- i) Notify your supervisor, and also submit written report with all useful information which you possess.

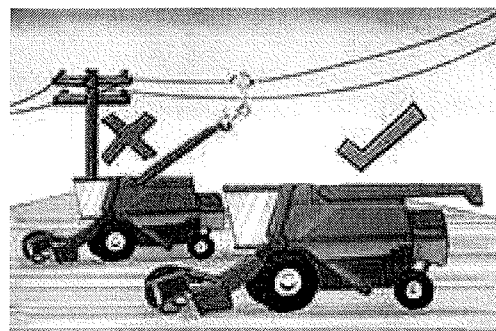
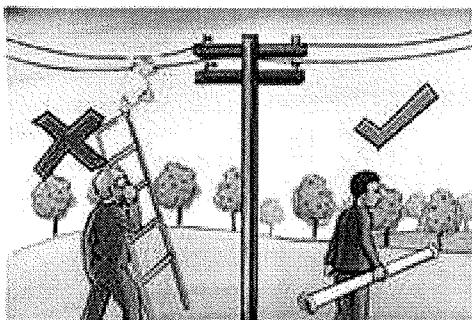
**Precautions during rigging and hoisting by using cranes, derrick etc.**

- Man in charge of working party shall be responsible for loading within safe limit and by proper use of ropes, chains, cables, slings, jacks, skid and other hoisting and rigging apparatus. In no case shall such equipment be used until the supervisor has inspected on each occasion and assured that it is free from defects and safe for use.
- Before operating a crane, derrick, Chain pulley block and other hoisting equipment, the Operator should sound a warning and accept only one person's signal to start raising, lowering or swinging load. However, the operator shall stop immediately upon signal from anyone.

- Employees shall familiarize themselves with the proper use of knots, ties and hitches and safe methods of hooking and slinging required in their work. Necessary training at periodical intervals and at induction level shall be provided.
- Particular care must be exercised to see that cables, chains and other hoisting equipments are not unduly stressed by improper use. All ropes, cables, chains, slings etc. shall be discarded when they are worn or have deteriorated to the point where their safe use may be questionable in the judgment of the supervisor / Safety Audit committee.
- Wire ropes or cable should have clips attached to cables; a sufficient number should be used.
- When applying U bolt clips to cables, a sufficient number should be used.
- Following precautions will preserve the strength and life of rope.
  - i) Do not drag rope on the ground unnecessarily as dirt chafes the fibres.
  - ii) Do not place kinked rope under stress.
  - iii) Do not tie knots where splices should be used. (Splice = rope)
  - iv) Do not allow ropes to become oil soaked, exposed to acid or corrosive substances.
  - v) Do not allow rope to remain exposed to weather any more than necessary.
  - vi) Carefully dry rope when it becomes wet.

### **TRANSPORTING AND STORING OF MATERIAL NEAR OVERHEAD LINES**

1. No rods, pipes or similar materials shall be taken below or in the vicinity of any bare overhead conductors or lines if they are likely to infringe the provisions for clearance under regulations 60 & 61 of CEA (Measures Relating to Safety and Electric Supply), Regulations 2010 unless such materials are transported under the direct supervision of a competent authorized line staff authorized in this behalf by the owner of such over-head conductors or lines.

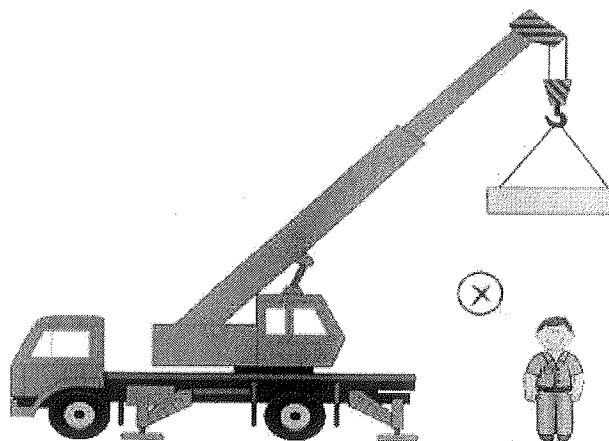


2. Under no circumstances rods, pipes or other similar materials should be brought within the flash over distance of the bare live conductors or lines.
3. Loading and unloading of construction material underneath the live lines, by raising the dipper of the lorry shall strictly be avoided.
4. For loading and unloading of poles, equipments and other line materials, sufficient manpower / machinery shall be allotted to carry out the work.

### Construction safety.

#### Transporting of materials.

- 1) When the poles are being loaded no person must stand between the pole and the conveyance. Nobody shall stand or pass under a suspended load. Load shall not be kept suspended for long time.



- 2) If the poles are to be transported on a flat type of trailer they shall be stacked neatly and fastened together tightly.
- 3) No person shall be allowed to travel on trailers loaded with poles.
- 4) Danger flags (red colour) shall be fixed at either end of the poles.
- 5) When unloading poles, no person shall stand on the unloading side.
- 6) During the course of transport of any equipment like transformers, etc, they shall rigidly be secured to the transport vehicle and packing material put on either side of the base of the equipment to prevent skidding. The loading shall be supervised by the competent authority.

- 7) No person shall be allowed to stand between the equipment and the sides of the transport vehicles.
- 8) While making turnings or going up or down inclines with loaded vehicles, very great care should be exercised in driving and over speeding should never be resorted to. The brakes of vehicles shall be specifically checked.
- 9) While transporting tall equipment, care should be bestowed for keeping the balance of the vehicle particularly at turnings.
- 10) When transporting particularly tall equipment, it should be ensured that there is sufficient clearance between overhanging branches of trees on roads and any telegraphic or other line and the top of the equipment (higher part of the equipment)
- 11) While transporting cable drums, it shall be ensured that the same shall be secured for its rigidity to prevent rolling down.

### **Erection work.**

- 1) Pole pits in sandy and collapsible soils should be shuttered and should not be dug much in advance of pole erection.
- 2) Warning 'DANGER' Boards should be exhibited on either side of the pits in inhabited areas.
- 3) Pits excavated on road sides in advance of pole erection shall be covered or suitably fenced before closing the works for the day, and before leaving the work spot.
- 4) During the erection of poles, the guy ropes shall be securely tied to temporary anchors like crow bars etc, driven to appropriate distance and the ropes are to be tightened to anchors, as the pole is being lifted into its position.
- 5) The slings lifting tackle etc, to be used in hoisting and erection of transformers and other equipment, shall be inspected and the officer in charge shall be thoroughly satisfied as to their mechanical strength in handling the weight.
- 6) While hoisting transformers on the D.P. structures, safety precautions by way of fixing additional clamps and bolts shall be taken and it shall be the responsibility of the person who is in charge of that work to ensure the same.
- 7) While working on the top of any structure the tools to the person working shall be tied through rope only and throwing of tools may lead to accidents, similarly after completion of work the tools shall be returned through a rope only.

- 8) While stringing conductors in any particular span which crosses another power line already in service, the following safety measures are to be taken
- a) If the crossing is of two pole lines only, a line clear shall be obtained on the power line in service and then only the work shall be commenced.
  - b) If the line that is being strung goes under a tower line, adequate care & precautions shall be taken for anchoring the conductor that is being strung by passing a loaded rope over the conductor so that the conductor may not fly up, and reach the vicinity of the live conductors.
  - c) Similarly when a line to be dismantled, the loaded point (cut point shall be dismantled first by simultaneous provision of temporary stays in such a manner that the pole shall not incline towards the other side due to the sudden removal of loaded portion.
  - d) While dismantling the conductor from insulators, the conductors in the both extreme ends of the faces of the line support (say x arm) shall be removed, then only the conductors in the inner ends of the faces of the pole on the x arm shall be removed.
  - e) While stringing the conductor it shall be through the drum only and not by pulling on road which may lead to the damage to the conductor.

### General precautions

- Whenever works are carryout by a contractor, the sole responsibility of safety of the working personnel working under him lies with the contractor. Agreements / documents shall contain the clauses fixing the above responsibility with the contractor appropriately.
- However the above works shall be supervised and intervened on short comings of safety.
- Whenever cables are laid it shall be properly jointed and well compounded.
- When cables are laid then appropriate depth on earth shall be maintained as per the table below.

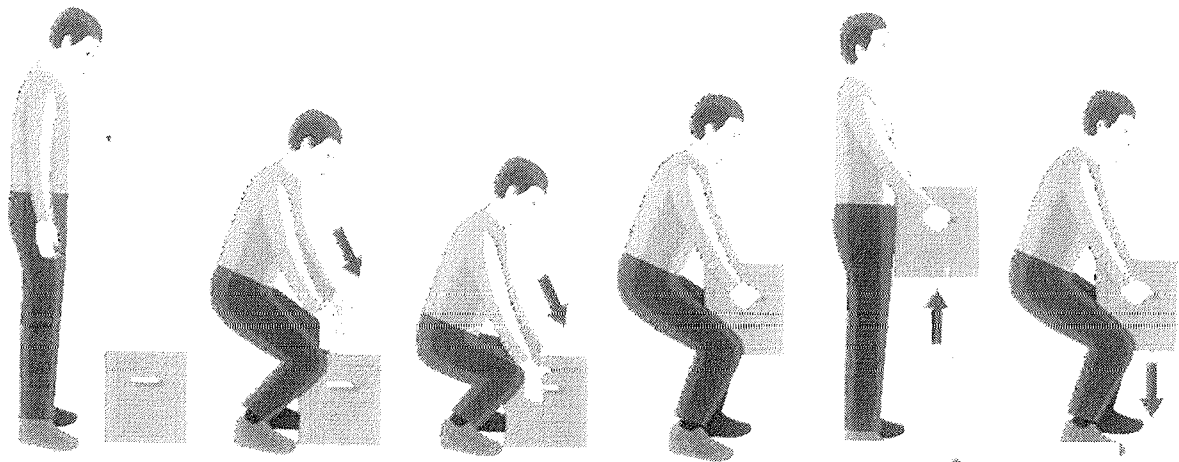
Voltage rating	Depth required (minimum) on road	Depth below railway track	Distance between Telephone cable	Depth below drainage	Min Dia of the pipe if the cable is laid through Pipe
LT	0.75 m	8 feet	1 feet	2 feet	10 CM
11KV	1.00 m				15 cm
33 KV	1.2 m				20 cm



- When the DT structures are erected on Road side, then the operating pipe shall be kept erected away from the road side.
- Care shall be exercised when DTs are erected near buildings, bridges or any infrastructure then it shall be ensured that no water flow due to rain water or overflow of water or passage of water shall come in contact with our structure or lines.
- If it happens that due to increase in height of the road the clearances may become inadequate and hence it shall be given suitable height to meet the statutory clearances.
- When DTs are erected near the over bridges, then it shall be ensured that at no case the live parts are accessible from any part of the over bridge.
- No DT / Lines shall be erected inside any educational institution.

### **MANUAL HANDLING CARRYING, PILING etc OF MATERIAL ANDEQUIPMENT**

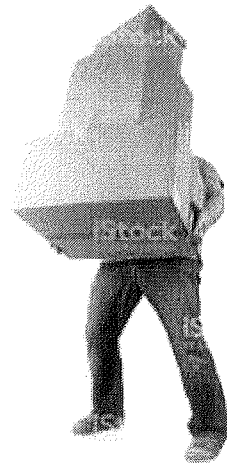
- If possible, the materials in the work site must be carried from one place to another by ropes, jacks, rollers, wheel barrows and wheel carts.
- The workmen shall be trained in safe methods of handling. They shall avoid the following;
  - ❖ Lifting with back.
  - ❖ Lifting too quickly and with a jerk.
  - ❖ Lifting while in an awkward position or with a poor footing.



The wrong way!



The right way!



- ❖ Handling load which are too heavy or loads which obstructs vision.
- ❖ Handling loads with sharp edges or corrosive materials without the use of suitable protective clothing and equipment.
- ❖ Raising or lowering of heavy objects by two or more workmen shall be governed by a well understood code signals to ensure unity of action.
- ❖ Only light loads should be lifted with various sizes of poly propylene rope.
- ❖ These ropes should not be used over sharp metal edges.

### **MECHANICAL HANDLING OF MATERIAL AND EQUIPMENTS**

- Suitable hoisting apparatus should be used for hauling and carriage of loads above 500Kgs.
- Slings for hoisting and other purpose may be made of chains, wire rope or fiber rope of sufficient strength to carry the loads.
- All slings should be provided with rings, shackles, links, hooks or I-Bolts of a proper size so that they could be safely suspended. All should have the same safe working load capacity.

### **HANDLING OF INSULATORS, CABLE DRUMS etc**

- The insulators should be packed in wooden crates and transported to the work site.
- Heavy objects and equipments should not be placed on the insulator crates.
- The insulator crate should be manually unloaded from the truck and carried to the worksite.
- The conductor as well cable drums should be loaded and unloaded with the help of chain pulley block or mobile cranes.
- The conductor and the cable drums should be stored over wooden sleepers.
- Before the insulators are raised up, they should be inspected for any possible cracks or chippings. Only sound insulators should be installed.

## **STRINGING OF CONDUCTORS**

- The conductor or the cable drum should be supported on the drum support and the paving out of conductor/cable should be done by rotating the reels in a direction indicated by the supplier.
- The paving out of the conductor should be done carefully avoiding any kink formation, rubbing against stones and other hard surfaces.
- In stringing of the conductors across railway lines, scaffolding should be done on either side of the railway line to ensure that the conductors are not allowed to lay on the railway track at any time of the work.
- Every reasonable effort shall be made not to interfere with P&T Lines and public property.

## **PROVISION OF SAFETY CLAUSE IN THE CONTRACT:**

As per the provision in Clause No.7(1) of CEA (Safety requirement for Construction, Operation & Maintenance of electrical Plants and electric Lines) Regulation-2011, owner shall incorporate the safety provisions in the contract documents which are required to be complied by the contractor's employees during execution of the contract to facilitate safe working during execution of the work. As per the provision in Clause No.7 (2), Contractor or Sub-contractor is responsible for the Safety adherence of their workman at work place.

## **CHAPTER - 5**

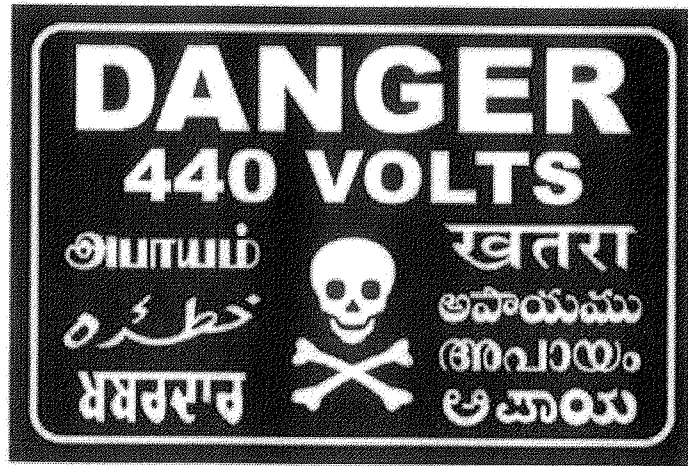
### **Safe Working in Sub-Station**

#### **General Safety Instructions:-**

- All Substations must have a single line lay out with specific markings of Switches / isolators / Earth switches including earthing locations.
- A Layout of source / feeding points of the substation shall be available including the location of switches / isolators/equipments in a conspicuous position.
- All sub stations shall have approved Operating instructions specifically for that particular substation incorporating all Standard Operating Procedure including for emergency and disaster also. The operating instruction shall also contain the operating procedure in coordination with all source sub stations.
- All the authorized personnel working in the Substation shall be aware and conversant of the Standard Operating instructions and it shall be ensured by the concerned Engineers.
- All substations shall have 1 key board and one LC board provided in an easily accessible inclose vicinity of the authorized operating personnel. The key boardis meant for housing keys which are normally in Service and the LCkey board which is identical to the other key board shall be meant for keeping the keys of the equipments / isolators / switches which are under Line clear/ breakdown. The LC board shall be kept under lock and key.
- For fast and effective communication (in case of emergency), the following phone or / and mobile numbers shall be readily available and displayed in the Control room in a conspicuous position :.
  1. Police station of concerned Area.
  2. Ambulance service.
  3. Government / private Hospitals (near to Substation).
  4. Fire Station
  5. Electrical Inspector.
  6. Substation in charge
  7. Security in charge
  8. EE / MRT & AEE / MRT concerned.

9. Phone No. of all EEs, AEEs and Section Officers of Distribution.

- Danger signs should be displayed to warn persons, the presence of high voltage equipment as detailed below.
  - As per regulation 18 of CEA Safety Regulation the owner of every installation of voltage exceeding 250 v shall affix permanently in a conspicuous position a danger notice in English and Local language.
  - On all supports of overhead lines of voltage exceeding 650 v which can be easily climbed upon without the aid of ladder or special appliances.



- Gates in switchyard fences and doors to bus compartments and other enclosures containing live equipment including AB switches should be kept locked at all times except when authorized staff are working on them.
  - There must be a clearance of 5 feet, between the SS fence and SS equipment and any metal part connected to the substation. The fence should be earthed at every 200 feet separately. Generally the fence and iron gate earthing should not be connected with the Sub station earthing.
- Unauthorized person should not be allowed inside a hazardous operation area like a bus compartment, switchyard etc. unless such person is accompanied by a responsible authorized person who shall always be present while such person remains in the area. Any person deputed to clean the yard or parts of the plant in such areas must be given clear instructions and a responsible person must be present while the person is carrying out the work to ensure that the person does not endanger his/ her own safety.
- Access to enclosure within chambers, cubicles or cells containing live high and/or extra

high voltage apparatus shall normally be provided with barriers and kept locked.

- Both the combined earth resistance and individual earth resistance of the power transformer and substation equipments should be measured annually in a dry day dry season.
- No person except an authorized person or a person acting under his immediate supervision shall have access to any enclosure, chamber, cubicle or cell in which a live section is exposed.
- Master keys of the locks on all chambers, cubicles on switchgear shall be kept safely with the Authorized Person and the other keys with the operator on duty. Key Boxes filled with locks shall be provided at suitable position for the early access of key in all circumstances.
- A key register shall be maintained wherein issue and receipt of all keys shall be entered with signature, name and designation and holders of such keys shall be personally responsible for its safe custody.
- Fire extinguishers and First Aid apparatus / Kit shall be provided and maintained in all sub stations as detailed in Chapter -10 & 11.

## **SAFE WORKING PROCEDURE**

### **Operations General Provisions:**

- All switching and other operations requiring engineering knowledge or skill shall be carried out by Authorized persons or competent persons acting under the immediate supervision of Authorized persons or competent persons.
- **The shift in charge shall not leave the SS premises in any case.**
- Except for switching required in case of emergency, no high voltage switching shall be carried out without the concurrence of the Competent Authority (System Operation/SLDC in case of Grid Sub-Station.)
- No high voltage earthing switch shall be operated or circuit main earth connection attached or removed without the instructions of the Competent Authority (System Operation in case of Grid Substation).
- The following precautions shall be observed in relation to switching operations:
- High Voltage / Extra High Voltage apparatus shall be operated by using rubber gloves/gauntlets accompanied by another person for assistance for Operation and for emergency if any.

- When low or Medium Voltage fuses, which are not in series with a circuit breaker, are to be operated, the operator shall use rubber gloves, insulated platforms or PVC mats.
- When replacing a low voltage fuse, which is in series with the switch, the switch shall first be opened and confirmed.
- Where isolators are in series with circuit breakers the circuit breakers shall always be opened and confirmed by operating crack switch that no current is flowing in all the three phases before opening isolators and conversely when the circuit is being closed the circuit breaker shall be closed after closing the isolator.
- Any abnormality in the condition or operation of any switch shall be reported to the person in charge of switching operations, immediately.
- Where there is interlock system to guard against irregular sequence of operation in switching, the failure of interlock shall not be taken as an excuse for incorrect operations.
- Following incidents and events shall be recorded promptly and accurately, in permanent ink on the Receiving Station/Sub-station in the Operation Log Book apart from the Operator hourly Log sheet.
  1. All disturbances, interruptions to service or imposed restriction of load together with reasons thereof should be recorded as above.
  2. Particulars of defects observed or reported in the substation or apparatus taken out of services as a result of the same, operating deviations, change of feeding conditions , change of DP status etc.
  3. Particulars of major overhauls, repairs routine inspections.
  4. All instructions/orders relating to operations issued or received or relayed through the Receiving Station/Substation together with the authority of instructions.
  5. All switching operations on High & Extra High Voltage switches, their timings and explanation of the reasons thereof. The time of applying and removing the earth rods in the feeders emanating from SS before giving LC and after returning LC.
  6. All clearance orders (i.e. Line clear-to-work, Sanction for test Station Guarantee, Self Protection tag etc.) received, issued or refused.



7. Particulars relating to telephonic message in connection with operations on high and Extra High Voltage Switches.
8. No entry on the log or register shall be erased under any circumstances. A wrong entry shall be cancelled by a single line drawn across it, so that it is not rendered illegible. The log sheet and the corrections thereon shall be authenticated by the Shift In charge.
9. In case of telephonic instructions, the Shift-in-charge shall not take any action until he/she has recognized the person giving instructions and read back the message to confirm the accuracy and authenticity of the same.
10. Apart from recording summary of all conditions in log book, before changing shift, the outgoing shift in-charge shall personally explain important special matters requiring special attention of the incoming shift in-charge. Incoming shift in-charge shall thoroughly understand the same and check the log book for correctness of such matters before taking over shift.
11. The procedure for issue / receipt of Line Clear is detailed in Chapter 10 of this manual for mandatory follow up.

#### **Maintenance General Provisions:**

- Equipment wears out gradually and the efficiency may reduce imperceptibly day by day. This gradual decline in equipment's performance can be determined only by systematic checking of the daily operation and inspection/condition monitoring of electrical apparatus.
- All switch-gear shall be inspected and tested after every major overhaul or repairs at periodical intervals (at every shut down if possible) not exceeding one year, as follows:
  1. For cleaning of all parts and lubrication as far as possible in every shutdown.
  2. Tightening of connections on wiring terminals, particularly those subjected to vibration;
  3. Checking condition of tripping, battery, fusible elements, indicator lamps, contacts and interlocks and effecting such replacements as may be necessary.
  4. Checking of relays, instruments and meters and effecting such readjustments as may be necessary.
  5. Entry holes for cable glands, dummy plates etc. shall be closed and sealed properly.
  6. All equipments and panels shall be vermin proof.
  7. The Maintenance Engineer shall prepare and maintain a suitable History

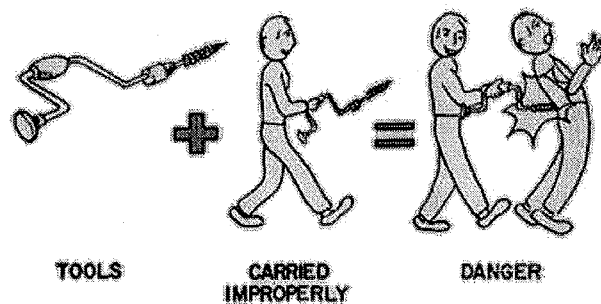
Book of each item of apparatus under his charge. No person shall carry out any work including maintenance repairs or testing on or in the vicinity of any electrical apparatus unless;

- In case of emergency to work in a high and/or extra high voltage apparatus, the work shall be taken up under a LC only with proper approval of competent authority and the safety requirements connected therewith should be complied.
- In the case of work on live apparatus on lines, no employee shall work on or touch any exposed parts of any apparatus or live line except when using adequate and approved protective device.
- Rubber mats of adequate insulation strength should be provided on the places of operation near the Control Panels and the same should be kept neat and clean and it shall be moisture free.
- As per 19(5) of CEA safety regulation, all non-current carrying metal parts of switchgear and control panels shall be properly earthed and insulating floors or mat conforming to IS 15652:2006 of appropriate voltage level be provided in front of the panels where such personnel are required to stand to carry out operation, maintenance or testing work.

#### **Safety precautions for work place containing exposed live area**

- Before commencement of a construction or maintenance work in an energized Substation, LC Permit shall be obtained from the authorised person and necessary precautionary measures for safety of personnel shall be ensured.
- Adjustment, cleaning and painting of earthed metal enclosures and structures may be carried out from ground level by competent persons only, under a danger notice, provided specified minimum working clearances are maintained.
- Mobile cranes and derricks shall be effectively earthed when being moved or operated in close proximity with energized lines or equipment.
- No person will be allowed to enter the switchyard with umbrella, stick, ladder, earth rod or any conducting materials in vertical position.
- Isolating of electrical apparatus should include;
  1. Isolation from all points from which it is possible for the apparatus to become live (e.g. voltage and auxiliary transformers, common neutral earthing equipment).

2. Locking of circuit breakers, isolators, control handles and safety device wherever such arrangements exist, in respective position.
3. Locking of all enclosures leading into live sections from the work area to avoid wrong opening of doors.
4. The section made dead for working should be only that section required for execution of the work the other live sections should be visibly attended by use of barriers, screens & danger Tags, etc., so that the minimum specified working clearance are maintained. The live sections should be bound by safety ribbon & flags during day and red lights during night along with manila rope to be fenced around the live area. Also Red flags shall be provided for such unsafe area during work in daytime. One inch manila rope may be tied round the danger zone at a height of say 3 feet from ground.
5. While working on or near any exposed live parts, minimum working clearances from the nearest exposed conductors to the place of work (e.g. ground level or working platform) should be maintained.
6. Ladder top to be tied with equipment on LC , when ladders are used.
7. No material or tools should be carried on shoulders. Long material and tools should be carried in horizontal position and in a manner to maintain the adequate clearances to live sections.



Following precautions should be observed in the **use of ladders and long objects in the work area inside the switchyard:**

1. Height of the ladders should be suitable for the work and not greater length than required for the work involved. These should be **transported horizontally** in the yard.
2. Movement and erection should be subject to direct supervision of the authorized person.
3. Portable ladders, when not in use, should be shrunk securely locked to a suitable anchorage.

4. Portable ladders provided for giving access to fixed ladders, should be padlocked in position by an authorized person while work is being carried out on the structures.
- Number of accidents has taken place in switchyards which are partly commissioned and where extension works are under taken by Contractors. As the work site is in the close proximity of charged bays, utmost care has to be exercised during erection of equipments and movements of materials, Tools & mobile crane etc. It is necessary to restrict entry & movement of contractor's men & materials in the charged areas of switchyard by barricading suitably. Further, all erection works should be undertaken under strict supervision of Board's engineers as well qualified Site Engineer from Contractor's side.
  - During Pre-commissioning checks on equipments in extension bays, Line Clear Permit should be taken prior to starting of work and only the Concerned Engineer/staff should be associated for such works. The Supervising Engineer (Construction or Maintenance) must avail Line Clear and should be present at the work site throughout the duration of such work until completion.

**Work on remotely and/or automatically controlled equipment:**

- A Line clear-to-work shall be obtained for all work on Control Equipment and its wiring or Relays. Before work is carried out on remotely or automatically controlled equipment such as Circuit breakers, Isolators, Tap changing gear or Compressors, the automatic or remote control features shall first be rendered inoperative by selecting local / remote selector switch, and removing AC/DC fuses, of the particular equipment / panel.

**Work on equipment operated by or containing compressed air:**

- Line clear-to-work shall be obtained before start of the work.
- Work, other than operating adjustments, shall be carried out only under the following conditions:
  - Operating adjustment on equipment operated by or containing compressed air, which require the normal air supply, may be carried out only when necessary and under the direct supervision of the authorized person.

### **Work in underground system:**

- No. person shall enter or be permitted to enter any underground chamber or other confined space in which dangerous fumes ,suffocating gases are likely to be present to cause danger unless
  - (a) It is provided with a manhole of adequate size or other effective means of access.
  - (b) A certificate in writing has been given by competent person based on a test carried out by himself, that the space is free from dangerous fumes and fit for person to enter, or
  - (c) The employee is wearing a suitable breathing apparatus and a belt securely attached to rope, the free end of which is held by a person standing outside the confined space.
  - (d) Open flames and smoking shall be avoided in under-ground chambers.
  - (e) Tools and materials shall be kept clear of the man-hole.

### **Work on transformer and oil storage tanks:**

1. Before an employee is permitted to enter any tank, it shall first be adequately ventilated and if necessary, the process of ventilation shall be continued during the entire period of work.
2. When an employee enters a tank, another employee shall be directed to stay in the immediate vicinity to render any aid that may be required by the person working inside.
3. Transformers removed from service due to internal trouble are likely to contain poisonous and explosive gases in large quantities. These shall be properly ventilated before undertaking repair work.
4. Oil storage tanks shall, in addition to being ventilated, be properly purged and cleaned before any employee is allowed to enter the same.

### **Working on Transformer (Power Transformer):**

- A Line Clear-to-work shall be obtained for all work on Transformers.
- For isolation purpose, both the primary and secondary voltage switches and isolators are opened and earth shall be done on work site. Similarly when isolating transformers, to which voltage transformers are connected, the voltage transformer shall be isolated and low voltage fuses removed to prevent the possibility of transformer being made live through the synchronizing or voltmeter plug.

- The transformers shall be isolated from all common neutral earthing equipment from which it may become live. This does not require the disconnection of solidly earthed neutral or neutral equipment connected solely to the transformer on which work is to be done.
- Whenever transformer is replaced, the new transformer shall be checked carefully for voltage, polarity and phase sequence, before commissioning into service.
- Transformers without conservators shall be treated as if the space above the oil level contains highly explosive gas and, therefore, the space shall be suitably ventilated before entering the tank, e.g., by keeping the manhole cover open for sufficiently long time or by circulating dry compressed air.
- Transformers which are provided with inert gas as a precaution against ignition of explosive gases in the space above the oil level shall not be entered until the tank has been ventilated with dry air or left open long enough to permit adequate natural ventilation.
- Open flames or inadequately protected portable lamps shall be kept away from the manhole and smoking shall not be permitted when working on or in the transformers.
- Checking of the nature of Gas collection at Buchholz , the gas shall be collected in a test tube and tested by flame test away from the Transformer and not by direct naked flame test.
- Persons working in transformers shall not carry any loose articles like key bunches, mobile phones, metal articles(Coins) in their pockets and persons working in or on the top of transformers shall not keep any loose tools around themselves, instead they must use Tool Holder.
- After the testing or Maintenance work done on the Transformer, it should be ensured that the tap position of transformer which is selected before the work carried out shall be same as per the other transformers operating in parallel.

#### **Working on Circuit Breaker:**

A Line clear-to-work shall be obtained for all work on HT circuit breakers. For isolation purpose it shall be ensured that:

- a) In multi bus / duplicate bus arrangements, supply from all the buses shall be isolated.
- b) Breaker is in open condition before opening respective isolators.

- c) Line and bus isolator have been checked open.
- d) There is no back-feed from potential transformers.
- e) Main fuses at the Control panel have been removed and DC voltage is disconnected from breaker mechanism.
- f) Tools and equipments are in safe working condition.
- g) When working on the mechanism with the breaker closed, block the trip latch so that it cannot be tripped accidentally.
- h) Isolators on both sides, control switches (or control fuses), relay trip blocking switches and compartment doors are open.
- i) After maintenance work is over, the breaker should be operated by relay operation as test check.
- j) Mechanical blocking, when necessary, to prevent unauthorized movement of the mechanism, installed.
- k) Circuit breakers, which have pneumatically operated mechanisms, shall not be blocked mechanically while the pressure remains in the breaker storage tank or tanks. Mechanical blocking may result in damage to the breaker.

**Additional precautions for work on Vacuum Circuit Breaker:**

- (a) Do not work on the interrupters or the mechanism unless the circuit breaker is in the "open" position and both the closing and opening springs are discharged and all electrical power is removed.
- (b) Do not allow anything to come in contact with the interlock roller on the right side of the mechanism.
- (c) Do not use contact separation that is less than the recommended open position breaker contact gap.
- (d) To measure the IR value of the internal circuit of breaker, the AC supply shall be disconnected and insulation Tester shall be used. . The measurement is made by connecting a 500 V insulation tester from the wire to Ground.
- (e) Do not attempt to remove or reinsert the vacuum interrupter in the interrupter support assembly.

**Working on Switch Board Panels/Control Panels:**

- Line clear-to-work or sanction-for-test shall be obtained for all work on Switch Board Panel/Control Panel.
- The panel to be worked upon shall be differentiated from others by wrapping safety ribbon on other live panels
- The switchboard panel shall be discharged and before handling any metal part or equipment check shall be made to ensure that the same is dead.

### Working on Bus Bars:

- Line Clear-to-work shall be obtained for all work on H.T/E.H.T. Bus Bars.
- In isolating the point of work from supply, care shall be taken to disconnect right points in case of sectionalized ring and mesh schemes of Bus Bars.
- Isolators/Switches closing on the section Bus Bars on which work is to be carried out shall be locked in open position and the closing mechanism rendered in operative.

### Working on Instrument Transformers:

- Line clear-to-work shall be obtained for all work on instrument transformers.
- The metal case of all instrument transformers shall be earthed. In handling instrument Transformers, the secondary of a current transformer shall not be opened while it is live.
- Before any work is carried out on an instrument or other device in a current transformer secondary circuit, the device shall be bridged (shorted) with jumpers, so that the circuit cannot be opened at the device. The circuit shall never be opened at meter connections until it has been bridged elsewhere.
- Potential transformer secondary shall never be short-circuited.
- Low voltage windings of potential transformers shall always have one side permanently and effectively earthed.
- The spare core terminals of secondary of CT shall not be kept open while working on these types of transformers or during replacement.

### Working on Lightning Arresters:

No work shall be done on a lightning arrester along with the earth wire unless it is disconnected from the live circuit and earthed at both the line and Earth terminals.

- Tanks of electrolyte or shields of oxide film lightning arresters must never be touched while arresters are energized.
- H.V. and E.H.V. lightning arresters where accessible, shall be provided with suitable fences against possible contact while the arresters are live. The gate of the fencing shall be kept locked and the keys under safe custody with the operator on duty.
- A Danger board shall be provided on the gate & on the fence.
- The flow of leakage current in the surge monitor shall be watched and recorded during every shift.



### Working on Capacitors:

- Line clear-to-work shall be obtained for all work on capacitors.
- For isolation of capacitors first open all cut outs or disconnecting device of the capacitors, then wait for at least 5 minutes for the internal resistor to reduce the voltage.
- Next short circuit and earth all terminals of the capacitors. The short circuited earthing jumper shall be left attached on the capacitors while work is being done.
- In short circuiting and earthing any capacitor or bank of capacitor no resistance or reactance shall be placed on any internal discharging circuit, but all individual capacitor terminals are to be connected to earth using the special leads where these are provided.
- In case of star connected bank of capacitors, neutral point shall be earthed before taking the work in hand.
- The H.V cables shall be treated as stored capacitor and after making cable circuit dead wait for at least 5 minutes before connecting to earth.
- The terminals of spare capacitor / capacitors that are kept idle shall be shorted with wire.

### Safety precautions for working on Storage Batteries.

- Only the authorized people who are familiarized with battery installation, charging and maintenance procedures should be permitted access to the battery area.
- Battery rooms should be well ventilated and should be provided with two nos. exhaust fans enough to ensure that pockets of trapped hydrogen gases do not get stagnated particularly of the ceiling of the two fans. One of the exhaust fan must be running on rotational basis.
- Smoking, open flames or the use of tools or any other devices that are liable to cause sparks, should be avoided in storage Battery rooms, since in the operation of a battery, hydrogen gas is formed which may be explosive, if ignited.
- When mixing electrolyte, **always add acid to water and not water to acid.** Pour slowly and stir constantly to avoid excessive heat.
- While handling Sulphuric acid electrolyte, always use goggles and acid/alkali proof apron and gloves. Avoid spilling electrolyte. If electrolyte comes in contact with the skin, rinse with water immediately and thoroughly.
- To reduce the shock hazard due to short-circuit, insulate the handles of all tools used for tightening connector bolts. Also, remove the jewelry that could produce short-circuit.
- Un-insulated/unprotected tools, lamps are prohibited, silk; Fur clothing creates static electricity, hence prohibited.
- Electric storage battery jars and cells, unless composed of glass, hard rubber or the insulating material, should be mounted on insulation supports.

- All battery connection shall be kept clean and tight so that sparking is avoided because of loose/corroded connections.
- The paint used on the Battery room walls should be fire retardant epoxy paint.
- The acid proof floor tiles are to be maintained without any breakage / deteriorations.
- Batteries in service beyond the life period must be replaced.
- Dismantled / unused batteries should not be kept. They should be disposed.
- While removing/replacing defective cells, the terminals of the adjacent batteries of the defective cell must not be shorted prior to opening to avoid short circuit.
- Battery voltage shall be measured after switching OFF the Battery charger.
- **A point of caution** - D.C. failure may occur during the intermediate period (if station supply fails). So to carry out the operation, adequate precaution is to be taken either to divert the load to stand by set (if available) or may be done during the Grid shut down period.

#### **Working on Cables:**

- Line clear-to-work shall be obtained before start of the work.
- For isolation of cables, open at least one set of disconnecting switches or remove fuses in every source through which the cable can be made alive including leads to the cable of potential transformers. Then discharge the cable to earth.
- Before digging out the point of cable fault, the authorised person shall determine the particulars of all cables in the vicinity of faulty cable.
- All cables in the vicinity of the fault point shall be exposed and identified to establish the identity of the faulty cable.
- Before a high voltage cable is cut, the Authorized Persons shall make definite checks to identify the cable and to ensure that the cable has been made dead and earthed. He shall then spike the cable in an approved manner at the point where the cut is to be made.
- Before any high voltage joint or chamber is to be opened in circumstances where it is not desirable to spike the cable entering the joint or chamber, the Authorized Person shall satisfy from cable route record and if necessary by approved tests, that the joint or chamber is associated with the particular cable which has been made dead and on which it is safe to work.
- After completion of work, the cable shall be properly tagged and its position entered in appropriate drawing. Necessary documentation must be maintained regarding the details of works undertaken.
- Employees shall not step on live cables even though they are insulated and enclosed in a dead sheath. Tools and material shall not be rested over the sheath of the cable.

## **CHAPTER - 6**

### **SAFE WORKING IN OPERATION & MAINTENANCE OF HT, LT LINES CABLES AND EQUIPMENT**

This unit deals with the safe working in O&M of HT, LT Lines Cables and equipment viz, 33, 22, & 11 KV feeders emanating from Sub stations, Distribution Transformers , its associated equipment, LT feeders & Service lines.

Works in the above may be classified in to

- a) Planned work for maintenance / extension /improvement.
- b) Unplanned work like attending to breakdown / fault or work relating to rectification of failure / replacement etc. that may arise due to natural calamities.

Before taking up any work, the following systematic approach shall be adhered to.

- The appropriate circuit to be switched OFF either by availing Line clear or BLINK.
- It must be borne in mind, BLINK is for only Opening of the Switches and not for working.
- Proper communication shall be made between the receiver of Blink and the Operator at the Shift of Substation giving the BLINK so as to understand the correct feeder, location, nature of work etc.
- After availing LC or Blink, the working personnel should open the switch on both sides of work spot and ensure that the supply is switched OFF from either side of the work spot as per their requirement.
- It shall also be confirmed that there is no possibility of supply through any other source to the work spot viz., generators, inverters, back feeding etc.
- After opening the appropriate switches by using PPEs, the switch shall be Locked and tagged out.
- Though now there may not be a provision for Locking at the AB switch handles at Field, necessary arrangements for fool proof locking shall be made within a time frame at Field for all the switches in the Distribution network by the Officers concerned.(DP, AB Switches of DT etc.,)

- It is mandatory to provide Locks with double keys to each workman in the field those who are authorized to carry out Maintenance, fuse off call etc. One key to be with the authorised workmen and another with the Section Officer / Supervisor.(Foreman / Line Inspector)
- The workmen shall compulsorily lock the Switches that have been opened by the Lock provided to him and the key shall be kept in safe custody with him.
- A Danger board in Post Office red Stating that "MEN ON LINE, DO NOT OPERATE" shall be provided on the switch location.



- The equipment / Lines shall be discharged and then effectively earthed at necessary locations at work spot irrespective of Earthing provided at remote locations (at the Substation end or at the Switch Location)
- Even for renewal of fuses Earth rods shall be provided at appropriate locations.
- Climbing in the structure shall not be done through the Operating pipe side.
- The HG / LT fuses shall be removed before starting the work.(only LT fuse right)
- If the scheduled work is of long duration, and if necessary, depending on the site conditions the jumpers at the nearest location shall also be removed. This is in addition to the Earthing and not as substitute for earthing.
- If the work is to be carried out on LT side of a HT/LT double circuit in single support, then it may be ensured that adequate clearances between HT and LT are available or otherwise necessary LC has to be got in the concerned HT feeder.
- Only minor works such as attending to fuse off call replacement of Pin insulator / Pin binding that requires works of small nature with less duration should be done in the LT circuit of HT/LT double circuit.
- The above works shall be carried out in the supervision of a person not lower than the rank of a Line inspector.
- Other major works if any to be carried out in LT circuit of HT/LT double circuit it should be carried out in the same support only if both the circuits are switched "OFF".
- If it is necessary to work on a HT line of HT/LT line wit HT on Top and LT on bottom, then both HT and LT line shall be switched OFF even the LT is fed from same HT feeder to avoid back feed from Genset.

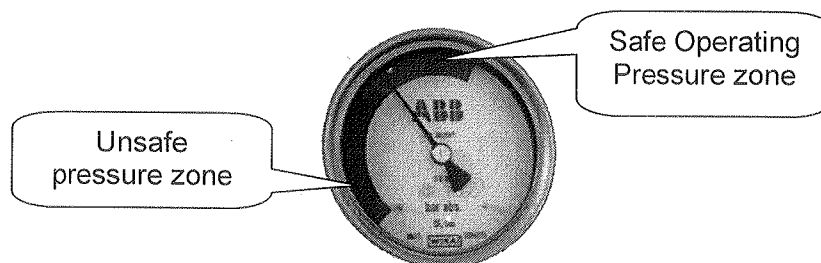
- If the work is to be taken on LT line with HT in service, then
  1. An Earth screen must be available between HT & LT Lines OR
  2. If the section officer satisfies himself it is safe to work on LT line with adequate working clearance, the work may be carried out with proper supervision not lower the rank of Line Inspector.

### **Working in DT Structures**

- Before starting the work on structures it shall be ensured that the structure is safe for climbing and whether the bottom portion of the structure / poles are free from deterioration.
- All the PPEs required shall be made available.
- All the procedures and precautions and method of execution of work and safe working places are kept in mind.
- All the tools shall be tied to a rope or tape so that it will not slip and fall down on others working / standing below the structure.
- If more than one person are to work on the same structure / pole, then the first person should climb and fix his position in a convenient working location. Then only the second person shall climb.
- Similarly while getting down; one person who climbed lastly shall get down. After reaching the ground only the other person shall get down.
- After climbing the structure / pole, waist belt rope shall be firmly tied to the cross arm or pole with proper knots and the knots shall be made in such a manner that they will not loosen by any action.
- The working person shall not make the knot with any insulator/ Conductors / Guys/ street light fittings and the loose end of ropes shall not rest on any of these parts.
- Only minimum required tools should be carried along with him and if required other tools may be lifted through a bag.
- While dismantling conductors it shall be ensured that no conductor from strained location shall be dismantled first. While doing so it may also be ensured that the pole must have adequate strength to with stand the strain due to dismantling. A temporary stay must be provided wherever necessary in such cases.
- If it happens that the conductors or materials are likely to fall on road side, then the road shall be blocked from traffic away for at least 10feet.

## Working in Ring Main Unit ( RMU )

- Ring Main Unit (RMU) is a compact, sealed for life metal-enclosed unit which includes a combination of one or more Load Break Switch (Isolator) cum Earth Switch as incomer and outgoing feeder and Vacuum Circuit Breaker with associated Disconnecter and Earth Switch for Distribution Transformers (DT) .All the switching devices and the bus bars are enclosed in a sealed for life SS enclosure filled with SF<sub>6</sub> gas to make the design compact while ensuring a high level of safety and reliability and also a maintenance-free system. RMU replaces the Distribution Transformer structure in the distribution network of TANGEDCO.
- RMU provides Clear indication of operation status via mimic diagram on front panel. All switching operations can be made safely to personnel because of interlocking system that operates automatically according to the switch position by the operator.
- The earthing connectivity of metal enclosures and DT neutral i.e Body earthing as well as neutral earthing should be intact.
- As a safety measure RMU has blocking system for operations. In this system, a blocking element made of metal sheet is used to block the insertion of operating handle in the earthing mechanism while closing/opening mechanism is under operating position. This blocking mechanism should not be tampered.
- The operator before proceeding with any operation has to confirm that the pointer on the SF<sub>6</sub> pressure indicator available in the front panel must be in the Green zone.



- When pointer is in red color zone the gas should be refilled, and none of the switching operation must be performed in that RMU (NOT SAFE TO OPERATE WHEN GAS IS LOW OR ZERO).
- Before operating the Circuit Breaker, it must be ensured that the spring is in fully charged condition otherwise it should be done by manually.

- In case of DT erection/ maintenance/ replacement, the breaker should be hand tripped, the isolator switch should be opened and earth switch should be closed. For Meggering of DT, the Earth Switch should be released and after Meggering, the earth switch should be brought back to the original position. After work completion first the Earth switch to be released and line switch to be closed. Finally breaker must be switched on for DT energization.
- In case of feeder fault or change over in supply, the isolator switch should be opened and Men On Line board should be provided to avoid any operation.
- In case of fault isolation by cables wing, high voltage is given for location of fault. At that time, the Earth switch should be in open position.
- Before starting the fault attending work, the Earth switch should be in closed position whereas while meggering, the Earth switch should be opened. After completion of fault attending work, the closed Earth switch should be released and Isolator switch (Line Switch) shall be closed after removal of Men and Materials.
- The RMU unit is controlled by SCADA system also for timely isolation of fault and maintenance of equipment from damage. While attending any local work in the RMU, the remote operation has to be disabled.

### **TEMPORARY EARTHING**

- Temporary earths are those applied at the actual location of the work, during repair, maintenance or construction of installations, for the protection of workmen, installations and public.
- Before providing earthing the line has to be discharged using discharge rod.
- Earth rods shall be of approved types, comprising properly designed clamps attached to insulated sticks of sufficient lengths to enable the clamps to be securely clamped to the conductors being earthed without necessitating an employee's hand approaching closer than the minimum safe working distances. Each such line clamp is to be connected by a flexible copper earthing lead of adequate length for attaching to permanent or temporary earthing spike.
- The earthing should be connected to clean rust free bolts / nuts / washers of equipment / installation / Earthing Electrode.
- When work is being carried out on a DT structure, the Earths shall be connected to the Earth electrode of the Structure and not any where else.

- Before doing any work on deadlines / installations or equipment where there is a possibility of their becoming energized from any source, such line / installation or equipment should be temporarily earthed between the location of work and all possible sources of Power.
- When Earthing lines / installations or equipments, the connection to the Earth shall be made first and then to the circuit or equipment last. In removing Earth, the connection to the circuit or apparatus shall be removed first and then the Earth connection last.
- Approved discharge rods should be used in making Earth connection to the circuit / installation or apparatus.
- Where two or more crews are working independently on same line / installation or equipment, each crew shall properly protect him/her by placing their own temporary Earth at both sides of the work spot where they are working.
- When it is necessary to disrupt a line, bus bar or cable or to repair a damaged conductor or damaged cable, earths shall be placed on both sides of the work. When removing earthing leads, they shall be disconnected from the line conductor first and the earth system last.
- All works on dead circuit shall be done in between two sets of temporary earths done by the authorized person only.
- Temporary Earths shall never be attached or removed with bare hands. Rubber gloves shall always be used.
- The person making temporary earths on structures/equipment / line shall maintain his position below the level of conductor to be earthed in order to keep the body away from any arc that may occur when the earth rod is connected to line / equipment / structure.
- No temporary earth shall be removed from the equipment while the work is in progress. Only authorized person has to remove the temporary earth.
- Employees shall not touch any conductor from which protective earths has been removed.
- Earthing of one conductor in one phase does not render other conductors in other phases safe for work. All phases shall be earthed even if work is to be carried out only on one phase.
- Temporary earth connections should not be connected to neutral wire, guy/stay wire or any other metal part of the structure except the place intended for it.



- The meaning of temporary earth is that it is done for the purpose of carrying out the specific work by creating around a safety zone for the protection of working personnel from electric shock.
- The temporary earthing connection to the lines should be as close to the point of work as possible.

### **Removing the Temporary Earth connections**

- On completion of work, removal of the earthing and short-circuiting devices shall be carried out in the reverse order to that adopted for placing them, that is, the end of the Earth rod attached to the conductors of the earthed mains / installations or apparatus shall be removed first and the other end connected to earth shall be removed last. The conductor shall not be touched after the earth rod has been removed from it.

### **Temporary Earthing: General precautions**

- The workman shall use rubber gloves and keep his body at least 60 cm. away from the earthing wire.
- Earthing leads shall not touch exposed live conductor.
- For work on transformers, earths must be placed on each terminal or each winding.
- Before working on capacitors or underground cables, they shall be disconnected from the source of energy, allowed for a time delay of 5 minutes and then discharged and earthed. (to avoid residual Charge being discharged)
- Where a neon lamp, potential light voltmeter phasing sticks, or other device is employed for testing of live circuit, the device shall be tested before and after use to ascertain that the device is in working condition.
- While working with overhead transmission lines, earths shall be placed on both sides of the work spot where work is being done.
- The receiving stations/Sub-station operator shall record the time of application and removal of the temporary earths provided in the feeders / lines emanating from the sub-station, in log book.

### **Additional precautions to be taken on lines for protection against lightning:**

- During construction of H.T. line, after the conductor has been pulled in place and sagged, one or more earths shall be placed on the tower nearest to the point of temporary dead end or the point of snub and allowed to remain until conductor has

been pulled in and sagged. New earths shall be put on or the old earth moved forwards as the sagging is completed. Always keep an earth connection between men working and the completely strung conductors.

- If during work on electric line, an electrical storm approach so close that there appears a likelihood of a direct lightning stroke to the line, the employees concerned shall descend from the towers and shall keep clear of them until the danger has passed.

#### **General safety precautions during work on any equipment or Line:**

- When any apparatus is not known to be adequately earthed, it shall be treated alive.
- Short circuiting of a circuit by a strap alone is not a safeguard until the short circuiting strap is properly earthed.
- Even though lines or other electrical equipment may have been isolated, they may be rendered dangerous due to induced voltage from neighboring circuits and therefore, they shall not be touched until the regular earthing procedure has been carried out.
- Never assume a circuit has been made dead, isolated and earthed on structures or towers with more than one circuit upon which work is being carried out, that any other circuit on the same structure or tower must necessarily be dead also.
- No earthing switch on high or extra high voltage apparatus shall be operated or temporary earth connections to such apparatus detached or removed except under the instruction of the authorized persons.
- While shifting the ladder in the switchyard special care shall be taken and the same should be shifted horizontally to avoid any contact with the live part.
- Earth discharge rods should be of adequate current and voltage withstanding capacity as per the requirement of the system and it should be of an approved one.
- The point of connection of earth discharge rod should be tightly fixed with the solid earthing ground and it shall not be a loose one.

#### **Special important works on the aspect of safety**

- Before taking up the maintenance work on Distribution Transformer Structure, it shall be ensured that the yard is kept neat and tidy as to whether there is any weed growth / water logging to avoid accidental earthing of the body of the operating personnel.
- The DT substation yard shall be spread with stone crusher jelly with a layer of 10 mm thick to minimise the appearance of Step and touch potentials which is safe to the operating personnel.

- The DT structure shall be fenced and locked to restrict access to un authorized persons and dumping of garbage waste.
- The street light wire of one distribution transformer shall not be extended to other distribution transformer.
- In any case the neutral of one Distribution transformer shall not be extended to any other Distribution transformer.
- In LT network, two feeder junction shall be avoided.
- In no case and in no location Bolts & nuts are used for the support of LT neutral conductor. Only Aluminium / GI knobs shall be used for the support of Neutral conductor to avoid snapping of neutral.
- Only strap sets shall be used at shackle points.
- Utmost care shall be taken while topping up of oil in the Distribution Transformer as to whether the container of Oil is free from combustible particles.(like petrol, Diesel, kerosene etc)
- While a person is working on the Distribution Transformer structure, no person shall stand under the proximity of falling objects so that no tools or equipments shall fall on the person causing injury.
- While working on Structures / Lines appropriate PPEs shall be properly used.
- As far as possible the person shall not have sharp objects in his pockets while working.
- Using of Mobile phone while working is strictly prohibited.
- Before the operation of the Ring main units (RMUs) it must be ensured that the SF6 Gas pressure inside the chamber is adequate. This can be ensured by seeing the pressure gauge of the RMU.
  - In no case the pillar box shall be in open condition and also it shall be ensured that the pillar boxes are erected with sufficient height above the flood level reached sofar.
  - There should not be LT line between two distribution transformers anywhere. In unavoidable locations, the span at appropriate location must be made dummy by creating Cut points on either end of the dummy span. The cut point must include individual phase wires, neutral wire and street light wire. Both the end poles shall be painted with **POST OFFICE RED** paint or distemper to demarcate the two feeder junction from other normal points in addition to keep a Board of caution "DANGER-TWO FEEDER JUNCTION" with Scull & Bone.



## CHAPTER - 7

# EFFECTIVE EARTHING PRACTICES TO ENSURE SAFETY

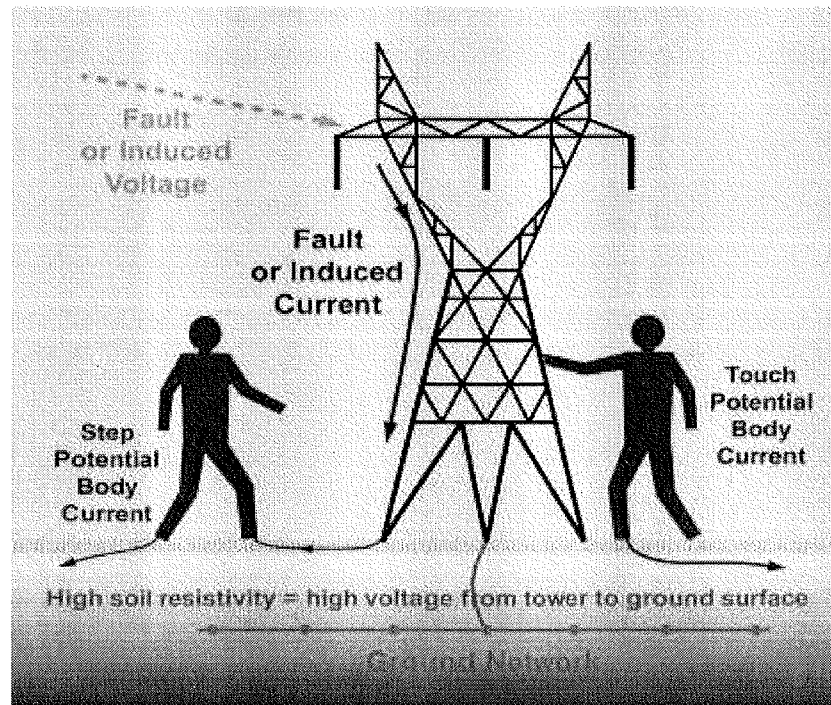
- Prime Objective of earthing is to provide a Zero potential surface in and around and under the area where the electrical equipment is installed or erected. This will provide safety to the operating personnel, public , and equipments.
  - To achieve this objective the non-current carrying parts of the electrical equipment, to the general mass of the earth which prevents the appearance of dangerous voltage on the enclosures of equipments, structures parts and poles and helps to provide structure parts, Iron poles, non-conducting line materials connected to the poles are connected safety to working Personnel and public.
  - Earthing is considered as life safety guardian for the working staff and general public whoever handles electricity. It is only the proper earthing that avoids accident, by blowing the distribution transformer fuse when an LT line snaps, by actuating the relay and tripping the breaker when HT line snaps and by actuating the Earth Leakage protection device when a fault occurs inside the consumers' premises. It is only the inadequate / improper earthing that has been the root cause for loss of many lives in the past.
- Therefore it is an absolute need for every human being to be aware of the significance of earthing and its methodology, which is the most important aspect in the sphere of electrical safety.
- 
- A good earthing system must possess the following dangerous potentials within safe value limits.

### TOUCH POTENTIAL:

If a man touches the metal part of equipment during fault, the maximum potential difference that will exist between hand and feet is called TOUCH POTENTIAL.

### STEP POTENTIAL:

The maximum potential difference between legs of a man when standing on the ground the pace being 1 meter between feet is called STEP POTENTIAL.



### **TRANSFER POTENTIAL:**

Transfer potential can result in electrocution path through human body. Potential rise of an earthing system caused by transferred earth current by means of a connected conductor (for example a metallic cable sheath, neutral wire, pipe line, rail etc).

To keep the above rise in potential within the allowable limit a layer of 10 mm thick gravel / crushed stone will be spread around the equipment which reduces the touch and step potentials to a low value by virtue of its high resistivity and non-continuous (discreet) path. Only in SS gravel / crushed stores are provided around the equipments in the yard.

### **Purpose of Earthing**

1. Ensuring personnel safety
2. Ensuring security of the system by restricting the potential within the level of insulation of the system.
3. Ensuring efficient and fast operation of protection system.
4. Eliminating accidents due to electromagnetic and electrostatic interference
5. Detecting Ground faults
6. Equivalent potential bonding between all contact points of the working area.
7. Reducing Electromagnetic Interference
8. Reducing Step Potential, Touch Potential and Transfer Potential and keeping them within limits.

- **All earthing systems shall:-**
  - a. consist of equivalent potential bonding conductors system capable of carrying the prospective earth fault current and a group of pipes, rods and plate electrodes for dissipating the current to the general mass of earth without exceeding the allowable temperature limits as per relevant Indian Standards in order to maintain all non-current carrying metal parts reasonably at earth potential and to avoid dangerous contact potentials being developed on such metal parts;
  - b. limit earth resistance sufficiently low to permit adequate fault current for the operation of protective devices in time and to reduce neutral shifting;
  - c. be mechanically strong, withstand corrosion and retain electrical continuity during the life of the installation and all earthing systems shall be tested to ensure efficient earthing, before the electric supply lines or apparatus are energised.
- All earthing systems belonging to the supplier shall in addition, be tested for resistance on dry day during the dry season every year.
- A record of every earth test made and the result thereof shall be kept by the supplier for a period of not less than two years after the day of testing and shall be available to the Electrical Inspector when required.
- The following conditions shall apply to the connection with earth of systems at voltage normally exceeding 125 V but not exceeding 650V namely:-
  1. neutral conductor of a 3-phase, 4-wire system shall be earthed by not less than two separate and distinct connections with a minimum of two different earth electrodes or such large number as may be necessary to bring the earth resistance to a satisfactory value both at the generating station and at the sub-station.
  2. The earth electrodes so provided, shall be inter- connected to reduce earth resistance.
  3. Neutral conductor shall also be earthed at one or more points along the distribution system or service line.
- In the case of a system comprising electric supply lines having concentric cables, the external conductor of such cables, shall be connected with earth (Regulation 48(5))
- The connection with earth may include a link by means of which the connection may be temporarily interrupted for the purpose of testing or for locating fault.

- No person shall make connection with earth or shall he keep it in contact with, any water mains not belonging to him except with the consent of the owner thereof and of the Electrical Inspector.
- Alternating current systems which are connected with earth as aforesaid shall be electrically interconnected: Provided that each connection with earth is bonded to the metal sheathing and metallic armoring, if any, of the electric supply lines concerned.
- The frame of every generator, stationary motor, portable motor, and the metallic parts, not intended as conductors, of all transformers and any other apparatus used for regulating or controlling electricity, and all electricity consuming apparatus, of voltage exceeding 250 V but not exceeding 650 V shall be earthed by the owner by two separate and distinct connections with earth.
- Neutral point of every generator and transformer shall be earthed by connecting it to the earthing system by not less than two separate and distinct connections.
- All metal casing or metallic coverings containing or protecting any electric supply line or apparatus shall be connected with earth and shall be so joined and connected across all junction boxes and other openings as to make good mechanical and electrical connection throughout their whole length:
- All Earth connections shall be visible for inspection
- Each Earth System shall be so devised that the testing of individual Earth Electrode is possible.
- The following are to be earthed effectively
  1. All metal parts including body of the equipments.
  2. Lightning arresters
  3. Neutral( Multiple Earthing)
  4. AB Switch handle
- In special locations, Railway and Telegraph line crossing, Special Structures etc., Pipe / Rod Earthing should be done.
- At all other locations Coil Earthing may be adopted.

**Earthing of Poles:**

- All steel poles on which switches, transformers , fuses etc., are mounted shall be earthed.
- All poles above 650V i.e., all HT poles for 33 KV/22 KV/11 KV lines irrespective of inhabited areas shall be earthed. For poles below 650V i.e., all LT poles, Guarding with continuous earth wire shall be provided and invariably connected to earth at every fifth

pole. Further all tapping poles, terminal pole, road crossing poles, service connection tapping poles, all poles in habitation area are to be earthed to create 'Multiple earthed Neutral System'.

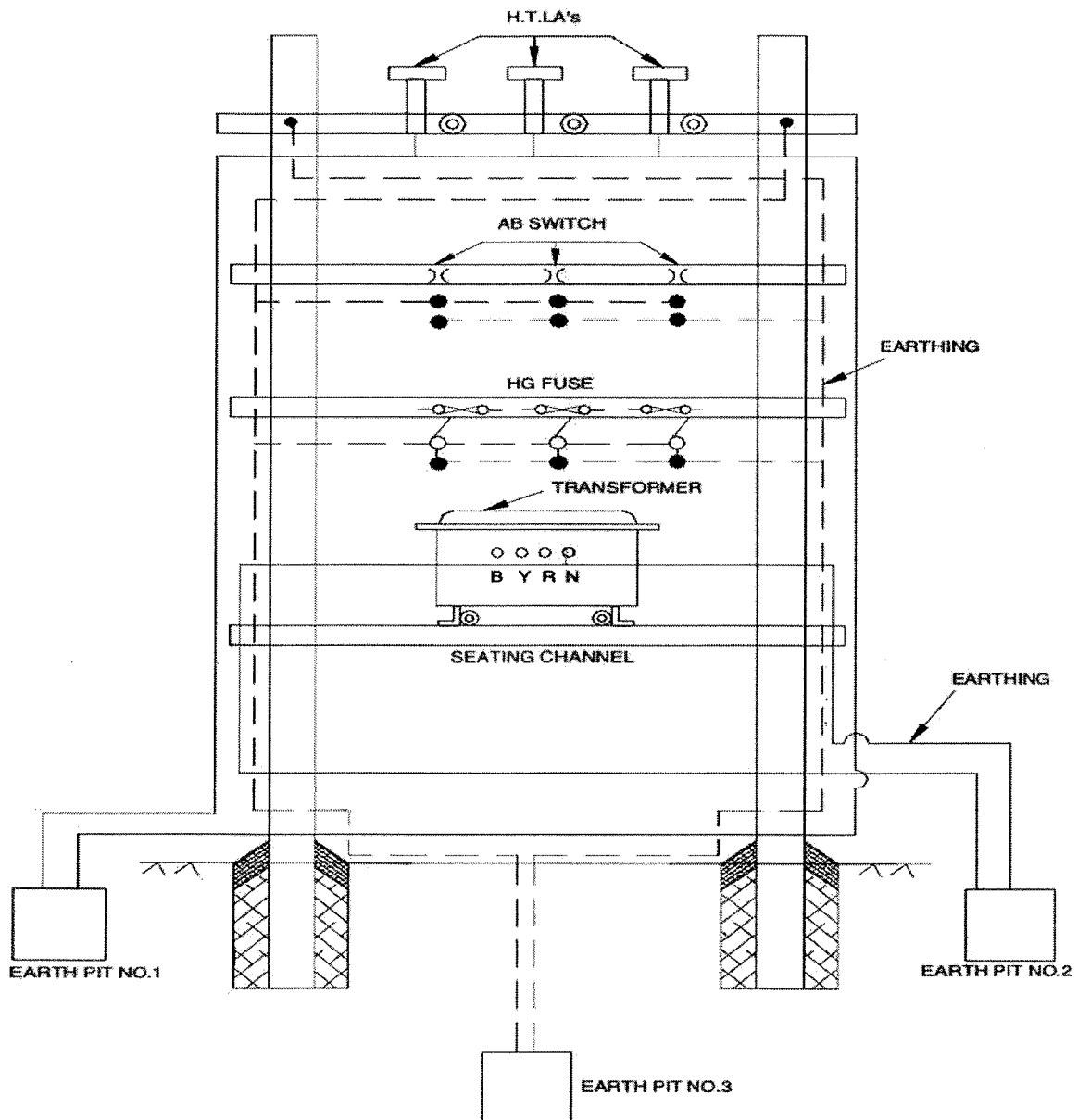
- Whenever the electric lines pass close to a well or a permanently moist place, an earth should be provided in the well or the marshy place and connected to the electric line pole.

#### **Earthing of Distribution Transformers:**

Pipe Earthing or Rod earthing shall preferably be provided for the distribution Sub- Stations as below.

- For earthing three earth pits in triangular formation at a distance of six meter from each other are to be provided.
- Earth pit should be digged for 45 cm x 45 cm size and 5 ft.depth, with a triangular formation of 6 meters distance.
- 3 Nos. of 40 mm dia and 2.9 mm thickness and 3 mts. (10 ft) length of G.I pipe perforated along its length should be used for earthing.
- At one end of the pipe a G I clamp should be welded and the other end made sharpened to be driven in to the ground for 5 feet.
- One direct connection through G.I wire, from the high voltage Lightning arresters and another direct and separate connections from the low voltage Lightning arresters ( if low voltage surge arresters are provided.) to the earth pit No. 1 as shown in the figure below.
- Two separate distinct connections through G I wire should be made from the transformer neutral bushing to the earth pit No. 2 only.
- Two separate distinct connections through GI wire from the following parts of the structure should be made to the earth pit No. 3 only as shown in figure below.:-
  - ❖ Metal part of the disc and stay.
  - ❖ Top channel.
  - ❖ AB switch frame, metal part of the insulator, side Arms.
  - ❖ HG fuses frame and metal part of the insulator.
  - ❖ LT cross arm, metal part of the insulator, open type fuse frame.
  - ❖ AB switch guide and operating pipe ( At the top and bottom)
  - ❖ Transformer body.
  - ❖ Belting angle.
  - ❖ Seating channel





- The inter connection of Earth Electrodes i.e. 2 & 3 shall be made except the one to which LAS earth is connected.
- Only 4 SWG GI Wire must be used for earthing. ACSR should not be used.
- The earth pipe should be buried for 5 feet and driven into earth to a depth such that the top of the earth rod is 200mm below the ground level. Pipes are buried with their tops below the surface of the soil in order to avoid direct contact to the neutral electrodes especially to animals which are liable to receive a dangerous shock during fault conditions.
- Neither the earth connections nor interconnections shall have joints in the conductors.
- 2 Nos. flat washers and one no. spring washer to be used.

- The connections shall be of firm and there should be no loose connections.
- Only GI bolt, nuts, washers to be used. No MS material shall be allowed in joints (bolts, nuts and washers) to avoid corrosion and hence earth resistance becoming high.
- GI wires shall be connected to earth pipe with 1 ½" x ½" GI bolts/nuts/washers through lugs neat by crimped. In no case the GI wire shall be wound over the GI Earth pipe.

#### Earthing in Sub Station :-

The earthing grid shall be designed as per IS 3043/IEEE 80. It shall be ensured that the grid resistance shall be such that the touch and step potentials are within safe limits.

The earth mat shall be provided at a minimum depth of 600mm in the substation/switchyard to provide low impedance discharge path for lightning, surge/system fault current to earth.

The earthing conductor size shall be designed for a life expediency of minimum forty years and for maximum fault current of time duration of 1.0 sec, whichever is higher. The minimum rate of corrosion of steel used for earthing conductor shall be considered as 0.12 mm per year for designing its size.

Pipe earthing with GI pipe of 3000mm long and minimum of 40mm dia shall be used as main electrode to be connected to grid conductor.

The risers from MS rod / Flat shall be provided upto a height of 300mm from ground level at different locations for equipment connection.

Main joints should not have contact area less than 150 sq.mm other joints should not have contact area less than 65 sq.mm.

Separate earth electrodes shall be provided for lighting mast, surge arresters, Transformer neutrals and VT. Each equipment shall be earthed at two points. AB Switch handles shall be earthed.

Metal pipes and conduits shall be effectively earthed at two points.

Metallic sheaths/screens and armor of multi core cables shall be earthed at both ends.

Metallic sheaths and armor of single core cables shall be earthed at switchgear end only.

Cable tray shall be earthed at minimum two points by GI flats to earthing grid. The distance between earthing points shall not exceed 30m.

The minimum size of earthing conductor for various equipment is given below:-

All the joints in the steel earthing system shall be welded and frequently inspected with anti-corrosive bituminous points, rusted surface shall be cleaned, polished, painted with aluminum paint and then a coat of bituminous paint.

### **Earthing of Cables :-**

All cable sheaths and armour, supporting channels / angles / metal parts must be bunched and connected to the main earth. Every structure erected with cable should be provided with pipe earthing of minimum two earth electrodes for effective earthing of cable, switches, switch handle and all non-current carrying metal parts.

### **Earthing of Pillar Boxes:-**

Every pillar box must be provided with 40mm x 3000mm GI pipe electrode connected with 6 SWG. The pillar box enclosures, neutral bus bar, cable glands, non-current carrying metal parts must be earthed.

Street Light Switch boxes: - All street light switch boxes shall be effectively earthed with 6 SWG wire.

### **Earthing of Line Materials :-**

CEA (Measures relating to safety and Electric Supply) Regulation 72 mandates the following stipulations :-

- All metallic supports shall be permanently and effectively earthed.
- Metal cross arms and insulators points on poles shall be bonded together and earthed at every pole for 33KV / 22KV / 11KV Lines and at every fifth pole for lines below 500V.
- The support on each side of road crossing, Railway crossing or River crossing shall be earthed.
- The cross arm, TI Fittings, clamps, Insulator pins shall be effectively earthed by providing a continuous earth wire and securely fastening to each pole.
- The earth wire which is securely connected with the metal parts of the pole must be permanently and securely connected to the earth coil of the pole.

### **Earthing of Service Connection Bearer wise :-**

- Metallic bearer wire used for supporting insulated overhead service connection wires shall be effectively earthed (Regulation 72(2))

### **Earthing of Guarding :-**

CEA Regulation to mandates earthing of guard wire at each point at which its electrical continuity broken.

As per this regulation the guarding provided under the road crossing span must be earthed at both sides of the guarding support.

### Earthing of Lightning Arrestors :-

CEA Regulation 74 mandates efficient means for diverting to earth any electrical surges due to lightning which may result into injuries.

The earthing for any lightning arrestor shall not pass through any iron or steel pipe, but shall be taken as directly as possible from the lightning arrestor without touching any metal part to a separate vertical ground electrode.

### Connections with earth for apparatus exceeding 650 V :-

All non-current carrying metal parts associated with an installation of voltage exceeding 650 V shall be effectively earthed to a grounding system or mat which shall

- i) Limit the touch and step potential to tolerable value.
  - ii) Limit the ground potential rise to tolerable values so as to prevent danger due to transfer of potential through ground, earth wire, cable sheath, fines, pipe lines etc.
  - iii) Maintain the resistance of the earth connection to such a value as to make operation of the protective device effective
- i. The Combined Values for Earth Resistance, shall not exceed the limits specified below .

1.	Generating Stations	0.5 Ohm
2.	Major sub stations	1 Ohms
3.	Other Sub Stations	2 Ohms
4.	Distribution Transformer Stations	5 Ohms
5.	Individual location	15 Ohms

### REQUIREMENT OF GOOD EARTHING

- Good earth should have low resistance
- It should stabilize circuit potential with respect to ground and limit overall potential rise.
- It should protect men material from injury or damage due to over voltage.
- It should provide low impedance path to fault currents to ensure prompt and consistent operation of protective relays, Surge arresteretc.,

- It should keep maximum potential gradient along the surface of the sub-station within safe limits during groundfault.

## **Procedure for Providing Temporary Earthing**

### **1) DTStructure**

- The earth rods used shall conform to the specifications as mentioned in Chapter.6 of this manual.
- The AB switch shall be opened by using Hand Gloves and confirmed that the all the three AB switch blades are fully opened.
- Before providing earthing, the ends of the earth rods shall be tightened firmly to the Earth pipe.
- Then the person who is making earthing shall climb through the pole and rest safely with wooden stick tied with rope and use waist belt rope and stand at a safe distance.
- He shall collect the earth rod from the ground and bring one of the earth rod to close proximity of the conductor after AB switch (arcing distance) and ensure that no arcing takes place.
- After providing Earthing the works may be carried out safely as specified.
- After completion of works, the Earth rods may be removed first with Gloves on hand and then connections removed from Earth pipe.

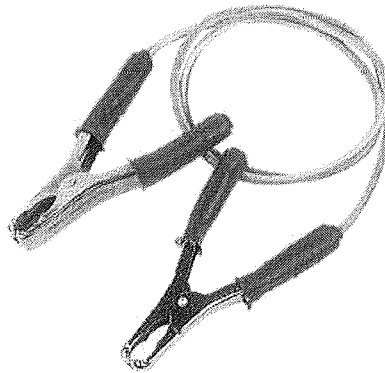
### **2) On HT / LT Lines:**

- Before starting the work necessary Line clear shall be obtained and it shall be confirmed that there is no supply in the work spot.
- Before providing earthing, the ends of the earth rods shall be tightened firmly to the pole earth
- If pole earth is not available, a metal spike may be driven to a depth of at least 3 feet and watering may also be done to get effective earthing. Then the leads of the earth wire shall be connected firmly to this spike
- Then the person shall climb the pole , stay in a comfortable position in the wooden stick tied with rope below the cross arm and with waist belt, approach the other end of one earth rod to all the phases within the arcing distance and if no arcing is found, then the earth rods shall be put to the line in all the three phases.

- After providing Earthing the works may be carried out safely as specified.
- After completion of works, the Earth rods may be removed first with Gloves on hand and then connections removed from the Earth.

### 3) PILLARBOX

- To attend a fault in a pillar box or in a cable emanating from the pillar box, the incoming LT supply to the pillar box must be disconnected.
- All the incoming and outgoing fuses must be removed from the pillar box in which the work is to be taken up. The incoming supply may be either from 4 way pillar box or 6 way pillar box or Distribution transformer itself according to the pillar box location. Hence we cannot generalize the incomer.
- Before taking up the work in a cable emanating from a pillar box, it must be ensured the cable is temporarily earthed.
- For temporary earthing, a set of three crocodile clips of sufficient current carrying capacity connected with wires of adequate capacity shall be used.



- Any one phase shall be connected to earth of the pillar box using the first set of crocodile clip and then the three bus bars are interconnected with the remaining 2 sets of crocodile clips.
- After completion of the work the crocodile clips on the bus bar shall be removed first and earthing shall be removed last and then the supply restored.
- During the entire process hand gloves shall be used.

Cable earthing

Fence earthing

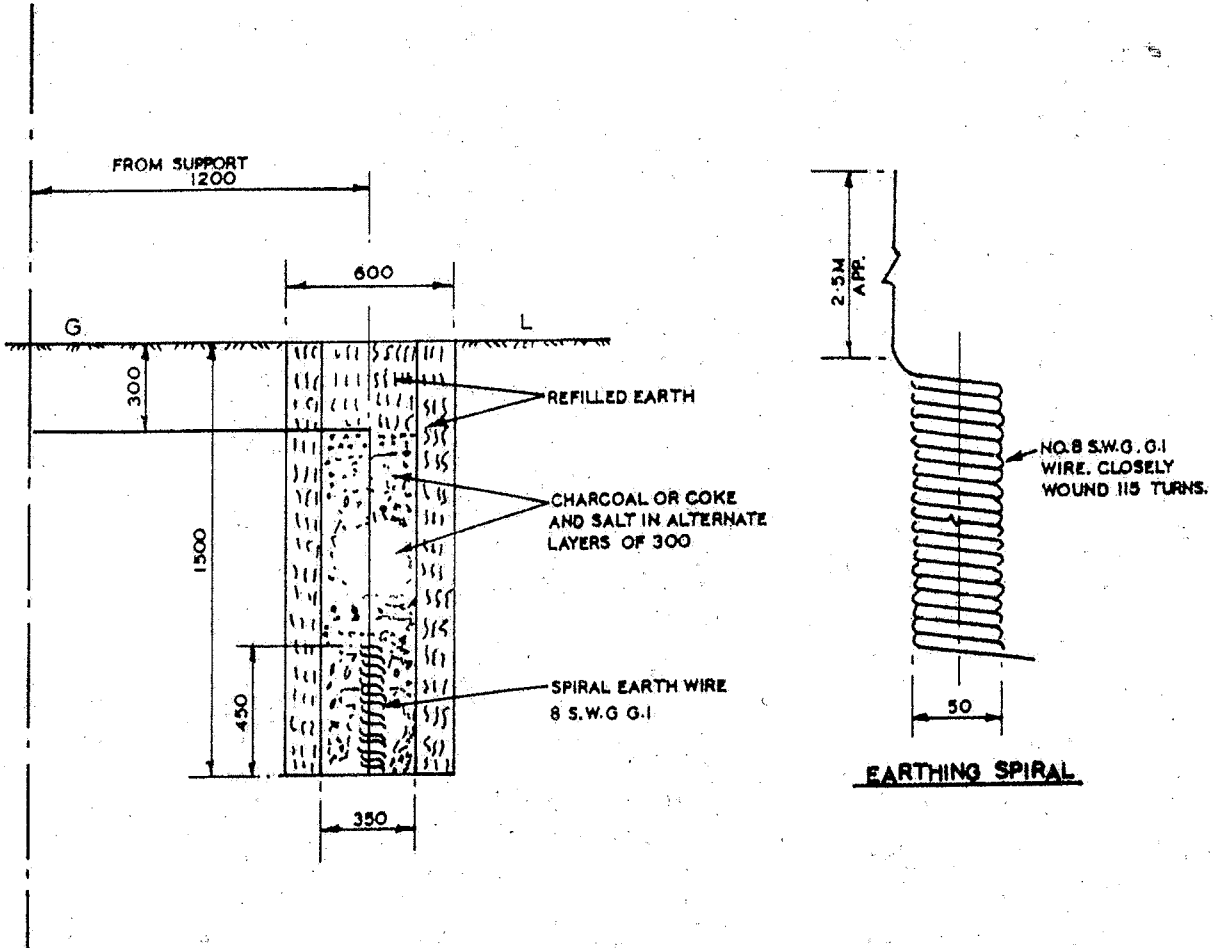
Street light box earthing,

Pillar box earthing

SS Earthing

Consumer premises earthing

REC  
CONSTRUCTION STANDARD  
J-1



**NOTE:-**

FOR PIPE EARTHING REFER CONSTRUCTION STANDARDS J-2.

ALL DIMENSIONS ARE IN mm.

कुंडली भू-सम्पर्कन

COIL EARTHING

SCALE:- N.T.S

SEPT. - 1972

## CHAPTER - 8

### SAFETY IN CONSUMER'S PREMISES

Safety for Consumers is of Prime importance, since they are the end users. Therefore care has to be exercised in effecting Service Connections and no safety regulation is compromised. The following which are in line with CEA regulations are to be adopted scrupulously.

- It shall be ensured that the Horizontal, vertical and other required clearances as stipulated in Chapter (13) are adequately met. If the clearances are inadequate, the consumer may be advised as per Annexure – 2, to get the lines deviated by proper application and on payment of appropriate charges wherever feasible.
- Each switch board shall have a clear space of not less than a distance of 1 metre in front of the Switchboard.
- Where bare conductors are used in a building the owner of such conductor shall
  - a) ensure that they are inaccessible, b) Provide in readily accessible position, switches for rendering them dead whenever necessary and c) take such other safety measures as necessary.
- No flammable / dust / waste shall be dumped under the meter / switch board. It shall be easily accessible in case of emergency.
- Each Service connection shall be provided with aerial cut-out fuse in the tapping point of the pole / box, such that in case of any overload / faults the supply to the premises will be cutoff.
- Supply shall not be effected to a Premises unless it is reasonably satisfied that the installation will not at the time of making the Connection cause a leakage from that installation or apparatus of a magnitude detrimental to safety which shall be checked by measuring the insulation resistance values
- All equipments shall have the IR Value as stipulated in the relevant IS.

Voltage level	Minimum IR value required (not less than)
Not exceeding 650 Volts (For single phase & Three Phase)	1(One) Mega Ohm *
exceeding 650 Volts but not exceeding 33000Volts (For HT)	5 (Five) Mega Ohm**



\* The insulation resistance measured on application of 500V Dc between each live conductor and Earth for a period of 1 minute.(Under de-energised condition)

\*\* The insulation resistance measured on application of 2.5 KV DC between each live conductor and earth for a period of 1 minute. (Under de-energised condition)

- Appropriate insulation testers (Megger) shall be made available in all the Offices from where Service connections are effected.
- The Value of the IR value shall be recorded in the test report and by which the measurement is made (Make, Sl.No. of the instrument) shall also be recorded in the Test report.
- The General terms such as “Satisfactory” or “OK” shall be avoided and values shall be recorded.
- At an interval of not exceeding 5 years every service shall be tested and the defects noticed shall be communicated to the consumer in writing.
- Upon inspection, if the IR value is found so low, as to prevent safe use of electricity, the service may be disconnected after issue of 48 hrs notice to the consumer of disconnecting supply and shall not re commence supply until it is satisfied that the cause of leakage has been removed.
- The Consumer shall be provided with an earthed terminal on his premises, for his use in an accessible position near the point of supply. (Explanation: Since our neutral is effectively earthed at Transformer location, the neutral can be considered as earthed terminal.
- For the installations of voltage exceeding 250V, the consumer shall in addition to the aforementioned earthing arrangement, provide his own earthing system with an independent electrode. (Explanation: For Three phase services, an additional Earth shall be made by the Consumer by an independent Earth electrode. The Earth Electrode resistance shall be recorded on the Test report separately.
- It shall be ensured that at no point, the neutral of the supplier shall be earthed by the consumer, but the consumer can earth their own equipments for protection.
- Any work within the Consumers premises including additions, alterations, repairs and adjustments to the existling except such replacement of Lamps, fans, switches, domestic appliances of Voltage not exceeding 250V shall be carried out by an Electrical Contractor licensed in this behalf by the state Govt. and by a person holding a permit issued or recognized by the Govt.
- New services / additional services / reconnection of services after a period of 6

months shall be tested and a RTR (Revised Test Report) shall be obtained. Testing of Services and IR values shall be as above.

### **Protection against Earth Leakage**

- Regulation 42 mandates the provision of Earth leakage protective device as follows.
- “The supply of Electricity to every installation other than voltage not exceeding 250V, below 2 KW and those installations of voltage not exceeding 250V, which do not attract the provisions of Section 54(Supply to X-ray installations), of the act shall be controlled by an earth leakage protective device whose maximum earth leakage threshold for tripping should not exceed 30 mA for domestic connection and 100mA for all other installations so as to disconnect the supply instantly on the occurrence of earth fault or leakage current”.
- Explanation:- For single phase Service connection, the consumer shall be insisted to provide mandatorily a Earth leakage protective device of rating not exceeding 30mA(trip) for Earth fault or leakage protection.  
For Other installations the Earth leakage protective device is of the rating not exceeding 100mA (trip)  
Further for 3 Phase service connections also the above regulation is applicable but with a connected load of below 2 KW. The details shall be recorded in the Test report and it shall be the responsibility of the person who is effecting service connection.
- If solar net metering is installed at consumer's premises, a separate earth pit to be maintained to prevent accident other than the above said earthing arrangement. The same shall be applicable to Generator set also and 4 pole isolation arrangement (TPN) must be provided.

### **Safety precautions in domestic installations**

- The wiring shall be done with Copper wires / cables of adequate size and good insulation resistance.
- Do not touch an electric switch / appliance when hands are wet.
- Be alert while replacing fuses / inserting plugs
- Proper fuse wires only shall be used
- Do not replace fuse unless cause for blowing out is detected
- Do not hang wet clothes on electrical fittings /conductors
- Use 3 pin plugs and ensure that earth connection is proper

## CHAPTER – 9

### STANDARD DISTANCES AND CLEARANCES

- This chapter deals with the standard clearances and spacing to be adopted in various electrical installations
- The relevant regulations of CEA on Safety Measures are reproduced here for strict adherence.
- Any amendments in the regulations will hold good for this chapter also.

#### GROUND CLEARANCE :-

**Regulation 58. Clearance above ground of the lowest conductor of overhead lines.-**

- 1) No conductor of an overhead line, including service lines, erected across a street shall at any part thereof be at a height of less than-

SI No.	Level of voltage	Distance in Meters
i)	for lines of voltage not <u>exceeding 650 Volts</u>	5 (19.1 ft)
ii)	for lines of voltage <u>exceeding 650Volts but not exceeding 33Kv</u>	6.1 (20.1 ft)

- 2) No conductor of an overhead line, including service lines, erected along any street shall at any part thereof be at a height less than-

SI No.	Level of voltage	Distance in Meters
i)	for lines of voltage not <u>exceeding 650 Volts</u>	5.5 (18.15 ft)
ii)	for lines of voltage <u>exceeding 650 Volts but not exceeding 33kV</u>	5.8 (19.14 ft)

- 3) No conductor of an overhead line including service lines, erected elsewhere than along or across any street shall be at height less than-

SI No.	Level of voltage	Distance in Meters
i)	for lines of voltage <u>up to and including 11000 volts</u> , if bare	4.6 (15.18 ft)
ii)	for lines of voltage <u>up to and including 11000 volts</u> , if insulated	4.0 (13.2 ft)

iii)	for lines of voltage <u>exceeding 11000 volts, but not exceeding 33000 volts</u>	5.2 (17.16 ft)
------	--	-------------------

- 4) For lines of voltage exceeding 33 kV the clearance above ground shall not be less than 5.2 meters plus 0.3 meter for every 33,000 Volts or part thereof by which the voltage of the line exceeds 33,000 Volts; Provided that the minimum clearance along or across any street shall not be less than 6.1 metres.

1. Ground clearances shall be as specified in schedule below.

**Regulation 60: Clearance from buildings of lines of voltage and service lines not exceeding 650 Volts.-**

1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing over head line.

2) Where an overhead line of voltage not exceeding 650 V passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed, namely:-

i) for any flat roof, open balcony, verandah roof and lean-to-roof-

1. when the line passes above the building a vertical clearance of 2.5 metres from the highest point, and
2. when the line passes adjacent to the building a horizontal clearance of 1.2 metres from the nearest point, and

ii) for pitched roof-

- a. when the line passes above the -building a vertical clearance of 2.5 metres immediately under the line, and
- b. when the line passes adjacent to the building a horizontal clearance of 1.2metres.

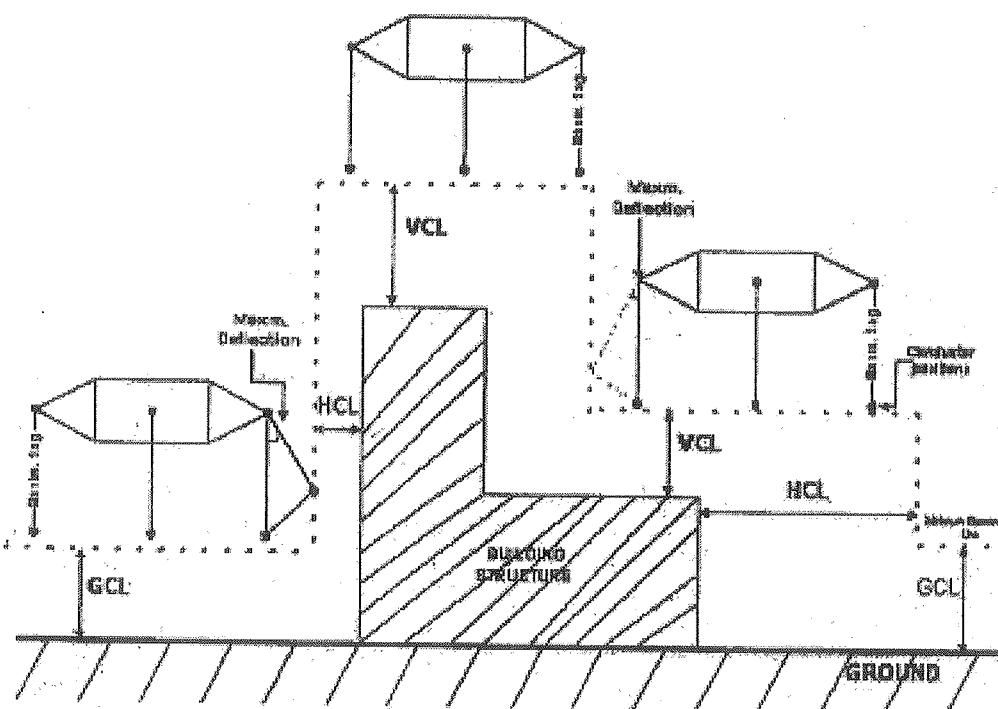
3) Any conductor so situated as to have a clearance less than that specified above shall be adequately insulated and shall be attached at suitable intervals to a bare earthed bearer wire having a breaking strength of not less than 350kg.

4) The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

5) Vertical and horizontal clearances shall be as specified below :-

## Schedule

### Ground, Vertical and Horizontal clearances [See sub-regulation (6) of regulation 58, sub-regulation (5) of regulation (60) and sub-regulation (5) of regulation 61]



**GCL:** Clearances as per Regulation 59

**VCL:** Clearances as per Regulation 60 & 61

**HCL:** Clearances as per Regulation 60 & 61

Explanation: - For the purpose of this regulation, the expression "building" shall be deemed to include any structure, whether permanent or temporary.

#### **BUILDING CLEARANCE :-**

##### **Regulation 61: Clearances from buildings of lines of voltage exceeding 650V.-**

- 1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line.
- 2) Where an overhead line of voltage, exceeding 650 V passes above or adjacent to any building or part of a building it shall have on the basis of maximum sag a vertical clearance above the highest part of the building immediately under such line, of not less than-

SI No.	Level of voltage	Vertical Clearance in Meters
i)	for lines of voltages exceeding 650 Volts up to and including 33,000 Volts	3.7 (2.21 ft)
ii)	for lines of voltages exceeding 33 kV	3.7 meters Plus 0.30 meters for every additional 33KV or part thereof

3) The horizontal clearance between the nearest conductor and any part of such building shall, on the basis of maximum deflection due to wind pressure, be not less than-

SI No.	Level of voltage	Horizontal Clearance in Meters
i)	for lines of voltages exceeding 650 Volts up to and including 11,000 Volts	1.2 (4 ft)
ii)	for lines of voltages exceeding 11000 Volts and up to and including 33,000 Volts	2.0
iii)	for lines of voltages exceeding 33 KV	2.0 meters Plus 0.30 meters for every additional 33KV or part thereof

4) Vertical and horizontal clearances shall be as specified in schedule:

Explanation: - For the purpose of this regulation the expression "building" shall be deemed to include any structure, whether permanent or temporary.

- Whenever applications are received from prospective consumers requesting Service connections to their premises irrespective of Tariff, it shall be ensured that the above Horizontal / vertical clearances are met out.
- If such cases arise on inadequate clearances, the applicant may be issued with a notice to get the adequate clearance by making arrangements for deviation of existing lines / poles / installations from the supplier on payment of the estimated cost
- Even after issue of notice to the applicant to pay the amount for deviation of the above, and the applicant does not come forward for deviation of the above, the applicant may be issued with a notice asking him to indemnify the supplier from any losses thereto due to the prevailing unsafe condition and make them clear that the supplier will not be held responsible for any untoward incident happens. OR The supply may be refused until the adequacy of clearance is met out

## CLERANCE BETWEEN CONDUCTORS OF DIFFERENT VOLTAGE :-

### Regulation 62 : Conductors at different voltages on same supports.-

Where conductors forming parts of systems at different voltages are erected on the same supports, the owner shall make adequate provision to guard against danger to linemen and others, from the lower voltage system being charged above its normal working voltage, by leakage from or contact with the higher voltage system and the methods of construction and the applicable minimum clearances between the conductors of the two systems shall be as specified in regulation 69 for lines crossing each other.

### Regulation 69 : Lines crossing or approaching each other and lines crossing street and road.-

Where an overhead line crosses or is in proximity to any telecommunication line, the owner of either the overhead line or the telecommunication line, whoever lays his line later, shall arrange to provide for protective devices or guarding arrangement and shall observe the following provisions, namely:-

- (i) when it is intended to erect a telecommunication line or an overhead line which will cross or be in proximity to an overhead line or a telecommunication line, as the case may be, the person proposing to erect such line shall give one month's notice of his' intention so to do along with the relevant details of protection and drawings to the owner of the existing line;
- (ii) guarding shall be provided where lines of voltage not exceeding 33 kV cross a road or street;
- (iii) where an overhead line crosses or is in proximity to another overhead line, guarding arrangements shall be provided so to guard against the possibility of their coming into contact with each other;
- (iv) where an overhead line crosses another overhead line, clearances shall be as under:-

(Minimum clearances in metres between lines crossing each other)

Sl. No	Nominal System Voltage	11- 66 kV	110-132 kV	220kV	400kV	800kV
1.	Low and Medium	2.44	3.05	4.58	5.49	7.94
2.	11-66kV	2.44	3.05	4.58	5.49	7.94

Provided that no guarding are required when line of voltage exceeding 33 kV crosses over another line of 250 V and above voltage or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the line of voltage exceeding 33 kV and the top most conductor of the overhead line

crossing underneath the line of voltage exceeding 33 kV and the clearances as stipulated in regulation 58 from the top most surface of the road maintained;

- (v) where an overhead direct current (DC) line crosses another overhead line, clearances shall be asunder:-

**(Minimum clearances in metres between AC and DC lines crossing each other)**

Sl.No.	System Voltage AC/DC	100 kV DC	200 kV DC	300 kV DC	400 kV DC	500 kV DC	600 kV DC
1.	Low and medium AC	3.05	4.71	5.32	6.04	6.79	7.54
2.	11-66 AC	3.05	4.71	5.32	6.04	6.79	7.54

- (vi) a person erecting or proposing to erect a line which may cross or be in proximity with an existing line, shall provide arrangements on his own line or require the owner of the other overhead line to provide guarding arrangements as referred to in clause(iii)and(iv);
- (vii) in all cases referred to in this regulation the expenses of providing the guarding arrangements or protective devices shall be borne by the person whose line was last erected;
- (viii) where two lines cross, the crossing shall be made as nearly at right angles as the nature of the case admits and as near the support of the line as practicable, and the support of the lower line shall not be erected below the upper line;
- (ix) the guarding arrangements shall ordinarily be carried out by the owner of the supports on which it is made and he shall be responsible for its efficient maintenance.

**Regulation 63 : Erection or alteration of buildings, structures, flood banks and elevation of roads.-**

- 1) If at any time subsequent to the erection of an overhead line, whether covered with insulating material or not, any person proposes to erect a new building or Structure or flood bank or to raise any road level or to carry out any other type of work whether permanent or temporary or to make in or upon any building, or structure or flood bank or road, any, permanent or temporary addition or alteration, head the contractor whom he employs to carry out the erection, addition or alteration, shall give intimation in writing of his intention to do so, to the supplier or owner and to the Electrical Inspector and shall furnish therewith a scale drawing showing the proposed building, structure, flood bank, road or any addition or alteration and scaffolding thereof required during the construction.



- 2) On receipt of such intimation, the supplier or owner shall examine,-
  - a) Whether the line or Underground Cable under reference was laid in accordance with the provisions of these regulations and any other law for the time being in force
  - b) whether it is technically feasible;
  - c) whether it meets the requirement of Right of Way (ROW);
  - d) whether such person was liable to pay the cost of alteration of the overhead line and if so, send a notice without undue delay, to such person together with an estimate of the cost of the expenditure likely to be incurred to so alter the overhead line and require him to deposit, within thirty days of the receipt of the" notice, with the supplier or owner, the amount of the estimated cost.
- 3) If such person disputes the cost of alteration of the over head line estimated by the supplier or owner or even the responsibility to pay such cost, the dispute may be referred to the Electrical Inspector who shall after hearing both parties decide upon the issue in accordance with sub regulation(4).
- 4) The Electrical Inspector shall estimate the cost of alteration of overhead line on the following basis, namely:-
  - i. the cost of material used on the alteration after crediting the depreciated" cost of the material which shall be available from the existing line or UG Cable.
  - ii. the wages of labour employed in affecting the alteration;
  - iii. supervision charges and charges incurred by the supplier or owner in complying with the provisions of section 67 of the Act, in respect of such alterations.
- 5) Any addition or alteration to the building or structure shall be allowed only after the deposit of such estimated cost to the supplier or owner.
- 6) No work upon such building, structure, flood bank, road and addition or alteration thereto shall be commenced or continued until the Electrical Inspector has certified that the provisions of regulation 58, 60 and 61 should not be contravened either during or after the aforesaid construction: Provided, that the Electrical Inspector may, if he is satisfied that the overhead line or UG Cable has been so guarded as to secure the protection of persons or property from injury, certify that the work may be executed prior to the alteration of the overhead line or UG cable or in the case of temporary addition or alteration, without alteration of the overhead line or UG Cable.
- 7) The supplier or owner shall, on receipt of such deposit, alter the overhead line or UG Cable in such a way that it does not contravene the provisions regulation 58, 60,61& 76 either during or after such construction within two months from the date of such deposit or within such longer period as the Electrical Inspector may permit for reasons to be recorded in writing.

#### **Regulation 64 : Transporting and storing of material near overhead lines.-**

- 1) No rods, pipes or similar materials shall be taken below, or in the vicinity of, any bare overhead conductors or lines if these contravene the provisions of regulations 60 and 61 unless such materials" are transported under the direct supervision of a person designated in this behalf by the owner of such overhead conductors or lines.
- 2) No rods, pipes or other similar materials shall be brought within the flash over distance of bare live conductors or lines.
- 3) No material or earth work or Agricultural produce shall be dumped or stored, no trees grown below or in the vicinity of, bare overhead conductors, or lines to contravene the provision of regulations 60 and 61.
- 4) No flammable material shall be stored under the electric supply line.
- 5) No fire shall be allowed above underground cables.
- 6) Firing of any material below electric lines shall be prohibited.

#### **Regulation 65.General clearances.-**

- 1) For the purpose of. computing the vertical clearance of an overhead line, the maximum sag of any conductor shall be calculated on the basis of the maximum sag in still air and the maximum temperature as specified under regulations 57 and computing any horizontal clearance of an overhead line the maximum deflection of any conductor shall be calculated on the basis of the wind pressure specified under regulations 57.
- 2) No blasting for any purpose shall be done within 300 metres from the boundary of a sub-station or .from the electric supply lines of voltage exceeding 650 V or tower structure thereof without the written permission of the owner of such sub-station or electric supply lines or tower structures and in case of mining lease hold area, without the written permission of the Inspector of Mines.
- 3) No cutting of soil within ten meters from the tower structure of 132 kV and above voltage level shall be permitted without the written permission of the owner of tower structure.
- 4) No person shall construct brick kiln or other polluting units near the installations or transmission lines of 220 kV and above within a distance of 500 metres.

#### **Regulation 66 : Routes proximity to aerodromes.-**

Overhead lines shall not be erected in the vicinity of aerodromes unless the Airport Authorities have approved in writing the route of the proposed lines as-per relevant Indian Standards.

#### **Regulation 67 : Maximum interval between supports .-**

All conductors shall be attached to supports at intervals not exceeding the safe limits based on the ultimate tensile strength of the conductor and the factor of safety specified under regulations 57.

Provided that in the case of overhead lines carrying conductors of voltage not exceeding 650 V when erected in, over, along or across any street, the interval shall not, without the consent in writing of the Electrical Inspector, exceed 65 metres.

**Regulation 68. Conditions to apply where telecommunication lines and power lines are carried on same supports.**

- 1) Every overhead telecommunication line erected on supports carrying a power line shall consist of conductors each having a breaking strength of not less than 270kg.
- 2) Every telephone used on a telecommunication line erected on supports carrying a power line shall be suitably guarded against lightning and shall be protected by cut-outs.
- 3) Where a telecommunication line is erected on supports carrying a power line of voltage exceeding 650 V, arrangement shall be made to safeguard any person against injury resulting from contact, leakage or induction between such power and telecommunication lines.

**Regulation 70. Guarding. –**

- 1) Where guarding is required under these regulations the following shall be observed, namely:-
  - (i) every guard-wire shall be connected with earth at each point at which its electrical continuity is broken;
  - (ii) every guard-wire shall have an actual breaking strength of not less than 635 kg and if made of iron or steel, shall be galvanised;
  - (iii) every guard-wire or cross-connected systems of guard-wires shall have sufficient current-carrying capacity to ensure them rendering dead, without risk of fusing of the guard-wire or wires, till the contact of any live wire has been removed.

**Regulation 71. Service lines from overhead lines.–**

No service-line of tapping shall be taken off an overhead line except at a point of support: Provided that the number of tapping per conductor shall not be more than four in case of connections at voltage not exceeding 650V.

**Regulation 72. Earthing.-**

- (1) All metal supports and all reinforced and pre-stressed cement concrete supports of overhead lines and metallic fittings attached thereto, shall be either permanently and efficiently earthed by providing a continuous earth wire and securely fastening to each pole and connecting with earth ordinarily at three points in every km. with the spacing between the points being as nearly equidistant as possible or each support and the metallic fitting attached thereto shall be efficiently earthed.
- (2) Metallic bearer wire used for supporting insulated wire of overhead service lines of voltage not exceeding 650 V shall be efficiently earthed or insulated.
- (3) Each stay-wire shall be similarly earthed unless insulator has been placed in it at a height not less than 3.0 metres from the ground.

### **Regulation 73. Safety and protective devices.-**

- (1) Every overhead line Which is not being suspended from a dead bearer wire, not being covered with insulating material and not being a trolley-wire, is erected over any part of a street or other public place or in any factory or mine or on any consumer's premises shall be protected with earth guarding for rendering the line electrically harmless in case it breaks
- (2) An Electrical Inspector may, by notice in writing, require the owner of any such overhead line, wherever it may be erected, to protect it in the manner specified in sub-regulation(1).
- (3) The owner of every overhead line of voltage exceeding 650 V shall make adequate arrangements as per relevant Indian Standards to prevent undesigned persons from ascending any of the supports of such overhead lines which can be easily climbed upon without the help of a ladder or special appliances.

Explanation,- For the purpose of this regulation, rails, reinforced cement concrete poles and pre-stressed cement concrete poles without steps, tubular poles, wooden supports without steps, I-Sections and channels' shall be deemed as supports which cannot be easily climbed upon.

### **Regulation 74. Protection against lightning.-**

- (1) The owner of every overhead line, sub-station or generating station which is exposed to lightning shall adopt efficient means for diverting to earth any electrical surges due to lightning which may result into injuries.
- (2) The earthing lead for any lightning arrestor shall not pass through any iron or steel pipe, but shall be taken as directly as possible from the lightning arrestor "without touching any metal part to a separate-vertical ground electrode or junction of the earth mat already provided for the sub-station of voltage exceeding 650 V subject to the avoidance of bends where ever practicable.

### **Regulation 75.Unused overhead lines.-**

Where an overhead line ceases to be used as an electric supply line:

- i. The owner shall maintain it in a safe mechanical condition in accordance with regulation 57 or remove it.
- ii. The Electrical Inspector shall, by a notice in writing served on the owner, require him to maintain it in a safe mechanical condition or to remove it within thirty days of the receipt of the notice.

### **Regulation 76.Laying of cables.-**

- 1) No underground power cable of voltage exceeding 33 kV shall be laid without a minimum underground depth of 1.2meters and all underground power cable shall be laid down as per IS 1255 where required depth is not available, a 3 core

cable be laid in GI / HDPE duct or hume pipe and same should be protected by PCC below and KCC above depending on site conditions. For a single core cable, same should be followed but the pipe used should be HDPE only.

- 2) No underground telecommunication cable shall be laid without a minimum separation distance of 0.6 meters to the underground power cable of voltage exceeding 33kV.

**Regulation 77. Protection against electromagnetic interference.–**

The owner of every overhead power line of voltage level 11 kV or higher shall submit proposal for obtaining Power Telecommunication Co-ordination Committee clearance to ensure safety of the personnel and telecom equipment.

**Minimum Safety working clearance where electricity at voltage exceeding 650 V is supplied, converted, transformed or used**

Highest System Voltage (kV)	Safety working clearance (Meters)
12	2.6
36	2.8

Note :-

1. "Safety working clearance" is the minimum clearance to be maintained in air between the live part of the equipment on one hand and earth or another piece of equipment or conductor on which it is necessary to carry out the work, on the other.
2. The above safety working clearances are based on an insulation height of 2.44m which is the height of lowest point on the insulator, where it meets the earthed metal, from the ground.
3. The "Highest System Voltage" is defined as the highest rms phase to phase voltage which occurs under normal operating conditions at any time and at any point of the system. It excludes voltage transients (such as those due to system switching) and temporary voltage variations due to abnormal system conditions (such as those due to fault conditions or the sudden disconnection of large loads).

**4. Clearance between HT lines of Same voltage on Same supports.**

Sl. No.	Voltage	Clearance between circuits (Vertical formation)	Phase to Phase each circuit
1.	11 KV	3 ½ feet (1.07 m)	3 feet (0.91 m)
2.	22 KV	4 ½ feet (1.37 m)	3 ½ feet (1.07 m)
3.	33 KV	4 ½ feet (1.37 m)	4 ½ feet (1.37 m)

### **5. Clearance between HT & LT line on same support :-**

Where HT & LT lines are run on the same supports the maximum distance between the lines shall be

- a). LT line & 11 KV Line - 3 feet (0.92 m)
- b). LT Line & 22 KV or 33 KV line - 5 feet (1.5 m)

If 2 or more lines are carried on the same pole the higher voltage line shall be erected above the lower voltage line.

### **6. Clearance between HT & LT line crossing :-**

1.	11 KV or 22 KV Line Crossing LT Line	4 feet (1.25 m)
2.	33 KV line crossing LT line	5 feet (1.5 m)
3.	11,22 or 33 KV line crossing 11,22 or 33 KV line	4 feet (1.25 m)

### **7. Clearance between Lines when Crossing at Mid Span and at Pole**

An overhead line crossing below another overhead line at a point between 2 poles carrying the upper line, shall not under any conditions, have less than following clearances between the conductors of such lower line and the nearer of the 2 poles of the upper line according to the voltage of the lower line.

1.	Low Voltage lines	4 feet (1.25 m)
2.	High Voltage lines	6 feet (1.85 m)

Where the conductors of the lower line are attached to insulators fixed to the poles carrying the upper line the above clearance shall not apply.

### **8. Clearances between Lines and Guard Wires :-**

1.	For L.V Lines	1 feet (0.3 m)
2.	For H.V. Lines	
	i). 11 KV	1½ feet (0.46 m)
	ii). 22 KV	2 feet (0.61 m)
	iii). 33 KV	3 feet (0.91 m)

### **9. Clearances between Power and Telephone Line on the same Supports :-**

1.	11 KV	5 feet (1.5 m)
2.	22 KV	6 feet (1.85 m)
3.	33 KV	7 feet (2.14 m)

## **10. Clearances and Spacing for outdoors**

### **1. Minimum Clearance for Outdoor equipments Rigid conductors in air for an Attended station.**

Sl.No.	Voltage level	Between Phases	Phase & Earth
1	33 KV	915 mm (6")	610 mm (24")
2	22 KV	610 mm (24")	460 mm (18")
3	11 KV	460 mm (18")	305 mm (12")
4	400 V	380 mm (15")	305 mm (12")

For flexible conductors the above clearances are to be maintained for the maximum amplitude of swing.

### **11. Clearance from Live parts to Ground in an Attended Outdoor Station**

Sl.No.	Voltage	Clearance
1.	33,22 & 11 KV	3658 mm (12 feet)

The bottom most portion of any Insulator or Bushing in services should be at an absolute minimum of 2750 mm (9 feet) from ground level.

### **12. Clearance between adjacent sections**

1.	33 and 22 KV	2743 mm
2.	11 KV	2591 mm

### **13. Clearance spacing for Switches :-**

The following are the typical values adopted by TNEB. The spacing varies for an "Isolator with Arcing Horns" and "Without Arcing Horns", the former being higher. The isolator with arcing horns is used before the Transformer only, where it is required to break the Magnetizing Current.

Sl.No.	Voltage level	Isolator without Arcing Horns	Isolator with Arcing Horns
1.	33 KV	765 mm (30")	1070 mm (42")
2.	11 KV	610 mm (24")	915 mm (36")

## Important norms for UG Cable laying works

The UG cable to be laid as per IS 1255/1983 – Code of practice for installation and maintenance of power cables upto and including 33 KV rating

Sl.No.	Description	Requirements		Clause as per Tender Specification	Clause in IS	
1	<b>Nominal Size of trench</b>					
		Width	Depth			
	For 33 KV Cable	0.6 m	1.2 m	For Single run		
		0.8 m	1.2 m	For Double run		
		1.06 m	1.2 m	For third run		
	For LT Cable	0.45 m	0.75 m	For Single run		
		0.65 m	0.75 m	For Double run		
2	Depth of trench					
		Upto 1.1 KV Cable	Above 1.1 KV cables			
	Single tier formation	> 75 cm	>1.2 mtr.	1.5.7.2	6.3.2	
	Vertical formation (more than one tier)	>75 cm + 30 cm for each additional tier	>1.2 mtr. + 30 cm for each additional tier			
Vertical formation (when protective covers are used) for both single and multi tier)	>75 cm + 25cm for each cable	> 1.2 mtr. + 25cm for each cable				
3	Width of trench					
	For single cable	45 cm			1.5.7.2	6.3.2
	More than one cable in HORIZONTAL formation	Width shall be increased such that the interaxial spacing between cable shall be atleast 20 cm.				
Clearance from the side of trench	Atleast 15 cm between axis of the end cable and sides of the trench					
4	M Sand (Clean, Dry) Cushioning dimension					
	HV Cable	Not less than 8 cm in depth			1.5.7.3	
	MV Cable	Note less than 8 cm in depth				
	MV cable where there is no possibility of mechanical damage	No need for sand cushioning				
5	V Trough dimension					
		Length	Width one end (inner width / outer width)	Width other end (inner width/outer width)		
	LT and 11 KV V Trough Length	1000 mm	198 / 256	140 / 198		
	33 KV V Trough length	790 mm	200/280	283/363		



Sl.No.	Description	Requirements	Clause as per Tender Specification	Clause in IS
6	<b>Laying Formations of Cables of different Voltages</b>			
	Along the road	LV/MV cables shall be laid farther from the Kerb line than HV Cables	1.5.2 (v) a	
	Power and Control Cable	Kept in different trenches with adequate separation	LV/MV cables shall be laid above HV cables in restricted space.	1.5.2 (v) b
	Cables cross one another	Cable of higher voltage shall be laid at a lower level than the cable of lower voltage	1.5.2 (v) c	
7	<b>Proximity to Communication cable clearance</b>			
	Crossing	Right Angle	1.5.3	
	Horizontal clearance	60 cm		
	Vertical Clearance	60 cm		
8	<b>Railway crossing Clearance</b>			
	Cables shall be laid in spun pipe / Cast Iron / Steel pipe at depth specified by railway authority		1.5.4	
	Minimum depth	1 mtr. From bottom of the sleepers to the top of the pipe		
	Station limit	Pipes laid upto a minimum distance of 3m from the centre of the nearest track on either side		
9	<b>Safe bending radius for XLPE cable</b>			
	Size of cable			
	MV 4 Core 240 sq.mm	12 * D	12 * 60 = 720 mm	1.5.1
	HV 3 Core 400 Sq.mm	15 * D	15 * 110 = 1650 mm	
	HV 3 Core 300 Sq.mm	15 * D	15 * 90 = 1350 mm	
	<b>D – Overall diameter of the cable</b>			
	At joint and termination	Individual cores of a multi core cable	1.5.1	5.3.2
10	<b>Way Leave details</b>			
	Way leave shall be obtained from concerned authority		1.5.5	
	For private property : Section 67 of EA 2003 shall be complied with			

Sl.No.	Description	Requirements	Clause as per Tender Specification	Clause in IS
<b>11</b>	<b>Laying in Pipes / Closed ducts – 1.10</b>			
	The diameter of the cable conduit or pipe or duct should be at least 1.5 times the outer diameter of cable			<b>6.3.4.3</b>
	Joins not permitted inside the ducts		<b>1.10.8.2</b>	
<b>12</b>	Testing before laying	Continuity and IR to be checked	<b>1.5.7.3</b>	<b>14</b>
<b>13</b>	Extra loop cable	3m surplus cable shall be left on each terminal end	<b>1.5.7.3</b>	
<b>14</b>	<b>Mini pillar box and 4 way Pillar box details – 1.7.1 &amp; 1.7.2.4 details</b>			
	Pillar walls – 2 Nos. (Concreting)	1.2 m (H) / 0.5 m (L) / 0.2 (W)		
	Colour washing	2 Coats over one coat of primer		
	Earthing	GI Earth pipe by TANGEDCO	GI Wire, Bolts, Nuts and washers supplied by contractor	
	PCC Foundation	1:1 ½ : 3 (Cement ; Sand : Blue metal) (using 12 mm to 20 mm HB Stone)		
	Plastering	1 : 3 (Cement : Sand) (12 mm thick)		
<b>15</b>	<b>6 way Pillar box details – 1.7.3.6</b>			
	Pillar walls – 2 Nos. (Concreting)	1.2 m (H) / 0.53 m (L) / 0.28 (W)		
	Colour washing	2 Coats over one coat of primer		
	Earthing	GI Earth pipe by TANGEDCO	GI Wire, Bolts, Nuts and washers supplied by contractor	
	PCC Foundation	1:1 ½ : 3 (Cement ; Sand : Blue metal) (using 12 mm to 20 mm HB Stone)		
	Plastering	1 : 3 (Cement : Sand) (12 mm thick)		
<b>16</b>	Route Markers	To be installed in		
		1) At intervals not exceeding 100 m	<b>1.9</b>	
		2) Change in direction of the cable route		
		3) Joint Location		

# CHAPTER - 10

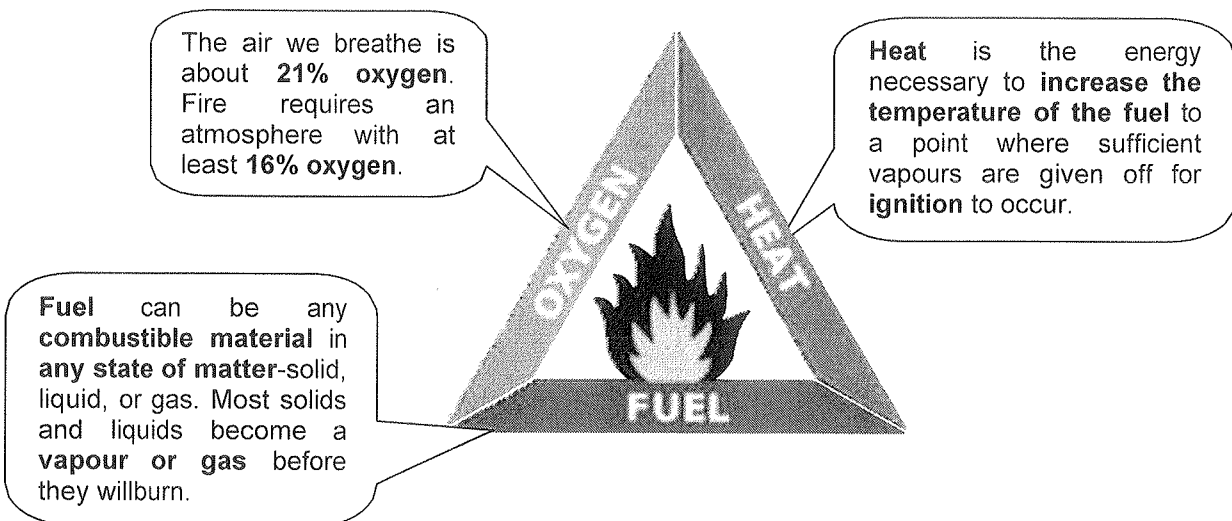
## PREVENTION OF FIRE & FIRE FIGHTING TECHNIQUES

Fire is the visible effect of the process of Combustion, releasing heat, light and various reaction products. In general the combustion or fire is a process involving rapid oxidation at elevated temperature accompanied by the evolution of heated gaseous products of combustion.

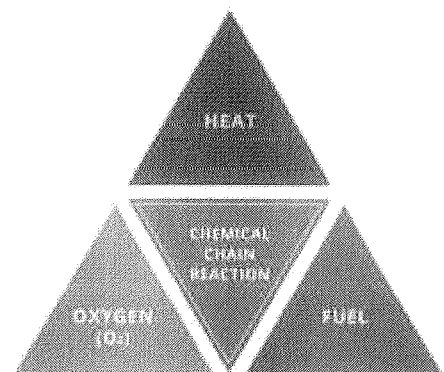
The discovery of fire, or, more precisely, the controlled use of fire, was one of the mankind's first great innovation which has made a breakthrough in his evolution. Controlled usage of fire / heat is essential in everyday livelihood of humans and many industries, at the same time if the fire becomes uncontrollable it leads to devastation of the life and property of him.

### Fire Basics :

A fire naturally occurs when fuel, heat and oxygen are present and combined in the right mixture, meaning that fire is actually an event rather than a thing. A Fire Triangle demonstrates the interdependence of these ingredients in creating and sustaining a fire.



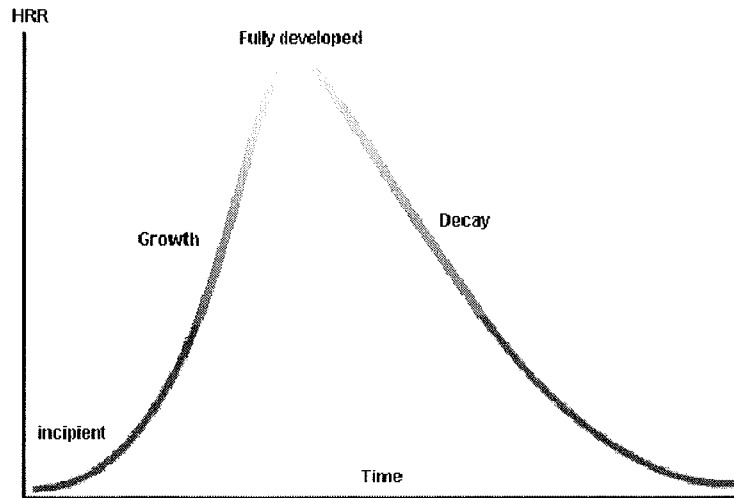
The combustion process can be more accurately represented by adding a fourth element in the above Fire Triangle called the „chemical chain reaction“. This is the chemical process where fuel reacts rapidly with a source of oxygen to create fire i.e. burning.



## Stages of Fire :

There are 4 stages of a fire, These stages are *incipient*, *growth*, *fully developed*, and *decay*. The following is a brief overview of each stage.

**Incipient** – This first stage begins when heat, oxygen and a fuel source combine and have a chemical reaction resulting in fire. This is also known as “ignition” and is usually represented by a very small fire which often (and hopefully) goes out on its own, before the following stages are



reached. Recognizing a fire in this stage provides your best chance at suppression or escape.

**Growth** – The *growth stage* is where the structures fire load and oxygen are used as fuel for the fire. There are numerous factors affecting the growth stage including where the fire started, what combustibles are near it, ceiling height and the potential for “thermal layering”. It is during this shortest of the 4 stages when a deadly “flashover” can occur; potentially trapping, injuring or killing firefighters.

**Fully Developed** – When the growth stage has reached its max and all combustible materials have been ignited, a fire is considered *fully developed*. This is the hottest phase of a fire and the most dangerous for anybody trapped within.

**Decay** – Usually the longest stage of a fire, the *decay stage* is characterized a significant decrease in oxygen or fuel, putting an end to the fire. Two common dangers during this stage are first – the existence of non-flaming combustibles, which can potentially start a new fire if not fully extinguished. Second, there is the danger of a back draft when oxygen is reintroduced to a volatile, confined space.

## **Classification of Fire :**

All fires can be separated into 5 different categories, depending on the type of fuel that is burning. Categorizing fires in this way makes it easier to choose the most appropriate method of fighting the fire.

### **Class A – Ordinary combustible fires**

These are probably the most common type of fire. They occur when materials become heated to their ignition temperature and will continue to burn as long as there is heat, oxygen and fuel to burn. Materials involved in these types of fires include paper, wood, textiles, rubber, some plastics and other organic carbon based compounds.

Class A fires are probably the easiest to extinguish as spraying them with water will cool the fire, removing the heat supply which is essential for the fire to burn. Water based or foam fire extinguishers are most appropriate for putting out ordinary combustible fires.

### **Class B – Flammable liquids**

Flammable liquids are those that have an ignition temperature of less than 100°C. These liquids also have a low flashpoint, which means that they burn easily. The flashpoint is the temperature at which a substance gives off enough vapour to be ignited. These liquids can however burn at any temperature if a source of ignition, such as a spark or naked flame is supplied.

Examples of liquids that are flammable include petrol, kerosene, alcohol, solvents and paints. Fires involving these give off a lot of heat and tend to spread very quickly. They also produce thick, black toxic smoke, which can make these fires difficult to fight.

The best approach for extinguishing a Class B fire is to use a foam fire extinguisher to smother the flames, as using water causes the fuel to scatter therefore spreading out the fire.

### **Class C – Flammable gases**

Flammable gases such as butane, propane and petroleum gases have the potential to create an explosion, if triggered by a single spark. For this reason flammable gases have to be stored securely in sealed containers. The LEL(lower

explosive limit) states the lowest concentration of flammable gas that will burn in air. This is usually around 5%, which shows just how big the danger is of potential explosions.

Fires involving flammable gases are one of the most dangerous types of fire to fight. Before attempting to put the fire out, you should make sure that the gas supply is isolated first. Most fire extinguishers are ineffective on Class C fires, the only type being suitable for use being dry power extinguishers.

### **Class D – Metal fires**

Certain metals and powdered metals can burn if ignited, although it requires a lot of heat to ignite most metals, as they are good conductors and transfer heat away quickly to their surroundings. Powdered metals and metal shavings are easier to ignite than solid lumps of metal, so pose a higher fire risk.

Alkali metals such as potassium, magnesium, aluminium and sodium can burn when in contact with air and water. Therefore putting water or foam onto metal fires will increase the intensity of the flames and result in potentially explosive reactions that will send pieces of burning metal in all directions.

In many cases with industrial fires where there are large amounts of burning metal, the safest approach is usually to let the fire burn itself out. As Class D fires tend to produce a lot of ash, this builds up and eventually starves the fire's Oxygen supply. If a metal fire is spotted early on, specialist type D powder fire extinguishers can be effective, although it should be ensured that they are the specific dry powder type, suitable for use on metal fires.

### **Electrical Fires**

Short circuits, overloaded switchboards, faulty equipment and damaged wiring can all cause electrical fires. Electrical fires are not strictly a fire class of their own, as electricity is a source of ignition as opposed to a fuel. They are still important to mention however as they have their own special fire safety requirements.

Before dealing with an electrical fire, the supply of electricity must be isolated as quickly as possible. **As water and foam has the power to conduct electricity, even once the electricity source has been cut off, you should not attempt to put out the**

fire by putting water on the flames or by using foam and water based extinguishers. Carbon dioxide and dry powder fire extinguishers are the only types of fire extinguishers recommended for safely tackling electrical fires.

### **Class F – Cooking oil fires**

Fires involving cooking oil and fats are common both in homes, businesses and professional kitchens. They pose a very difficult challenge to extinguish, due to the high temperatures involved. Simply trying to cool the fire with water will not work; in fact using water on a burning pan is likely to cause a rapid spreading out of the flames, making the fire worse and potentially injuring anyone in its vicinity.

For this reason special fire extinguishers have been developed to address Class F fires. Wet chemical extinguishers contain a formula which cools the fire and then emulsifies to seal the surface and prevent re-ignition.

### **Extinction of the fire**

A fire can be controlled and put out by disrupting the elements that form the Fire Tetrahedron for which we need to do one or more of these four things:

1. **Remove fuel sources.** This can be a preventative measure i.e. making sure potential fire hazards are stored safely or if a fire has started you can use water to disperse the fuel sources and to cool them.
2. **Cool the burning materials with water.**
3. **Exclude oxygen.** For example, with a fire blanket to prevent oxygen from reaching the process.
4. **Break the chemical reaction.** It is the chain reaction that keeps a fire going.

### **Different types of fire extinguishers :**

**There are different types of fire extinguishers for fighting various classes of fire.**

In the instance of a fire emergency, the last thing you want to be doing is reading the side of an extinguisher trying to figure out if you can use it to fight the flames. Being able to immediately distinguish them apart could make a lifesaving difference.

Fires come in many forms, so you need to familiarize yourself with how to properly and swiftly extinguish whichever type of fire you face.

Each type of fire extinguisher is ergonomically designed for the safe and effective discharge of its contents. They each contain different materials that make them suitable for fighting certain types of fires. The correct one must be used for the right class, otherwise they may prove ineffective or in fact aggravate the fire.

**Note :** None of the extinguisher mentioned below are suitable to deal with a large fire as all these are essentially first-aid fire-fighting appliances, however, these are very valuable, if used promptly and efficiently in the early stages of fire.

There are five main types of fire extinguishers:

1. Water
2. Powder
3. Foam
4. CO2
5. Wet chemical

Each type is easily identifiable by their names, colours, and sometimes their hoses; it's easier than you think to identify them from one another. Let's take a look at each type of fire extinguisher, their uses, and their risks.

## **1. Water**

### **Water extinguisher**

These types of fire extinguishers will be solid red and will have the word "water" printed across them. they dispense water at a high pressure to extinguish flames.

Water extinguishers are **only suitable for class A fires**, which means they can fight fires that involve wood, cloth, paper, plastics, coal, and other similar materials.

**Warning:** do not use on burning fat and oil fires and electrical appliances!





## Water spray extinguisher

These types of fire extinguishers will be solid red and have „aqua spray“ printed across them in white text. They are more effective at fighting fires than the traditional water ones because they spray water over a wider surface area and at a higher pressure.

Like its traditional counterpart, they are **only suitable for class A fires**.

**Warning:** do not use on burning fat and oil fires and electrical appliances.

Both water and water spray extinguishers can sometimes contain chemical additives that improve their effectiveness by up to 300%. The chemicals remove the water's natural surface tension so that it soaks into burning materials more effectively when used.

## 2. Powder

### **ABC Powder Extinguisher (Dry Chemical Powder)**

These types of extinguishers will say „powder“ in white text over a blue rectangle, and underneath the rectangle will be written „ABC powder“.

As their name suggests, these are **designed to combat class A, B, and C fires** – those involving solids, liquids, and gases. The powder acts as a thermal blast that cools the flames so burning cannot continue. Due to their non-conductive nature, they are **also suitable for fighting electrical fires**. However, they do not effectively penetrate the spaces in equipment easily, so the fire could still re-ignite.

**Warning :** do not use on domestic chip or fat pan fires (class F).

The **downside to ABC powder extinguishers is that they pose a danger of inhalation** when used in close spaces. They also leave residue behind that is difficult to clean up and causes damage to soft furnishings, carpets, and computers.



### 3. Foam

These types of extinguishers are identifiable by the word "FOAM" printed within a cream rectangle on their bodies. Foam extinguishers are primarily water based and contain a foaming agent, which has rapid flame knock-down and a blanketing effect – it smothers the flames and seals vapours so that re-ignition cannot occur. **They are suitable for fighting class A and B fires.**



When used against class A fires, the user can simply point and spray. However, when used against class B fires – those with flammable liquids – they should not be sprayed directly into the liquid. This could cause the fire to be pushed and spread to surrounding areas. The best method of application is to spray the foam nearby so that it can build up and flow across it.

**Warning:** these should not be used on any other fire classes, especially chip or fat pan fires. Most foam extinguishers will have had di-electrical tests performed on them, so foam is less hazardous than water if it is accidentally sprayed on live electrical equipment. However, they should still not be used to fight electric fires.

### 4. Carbon Dioxide(CO<sub>2</sub>)

These types of extinguishers can be identified by the text "CO<sub>2</sub>" printed in white on a black rectangle. They also have a distinct type of horn like hose unlike other extinguishers.

Carbon dioxide extinguishers are **used for combating class B and electrical fires** – they suffocate the fire by displacing oxygen in the air. Because they do not leave any substances behind, unlike other extinguishers, they **are particularly useful for offices and workshops where electrical fires**



**may occur** as they minimise damage done to equipment. . Also bear in mind that while carbon dioxide is effective at smothering fires, once the gas has floated away, the fire may re-ignite if the source has not been removed.

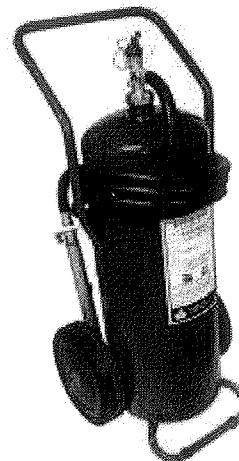
## 5. Wet Chemical

These types of fire extinguishers are identifiable by the words “wet chemical” printed across a canary yellow rectangle. It also has an extended applicator.

Wet chemical extinguishers are **designed for combating fires that involve class F fires**. They are effective because they are capable of dissipating fires that are of an extremely high temperature – namely, cooking oils and fats.

### Other types of Fire Extinguishers

**Wheeled fire extinguishers** are also available, which have a greater capacity, volume, flow rate, range, and discharge time (not to mention the added convenience of not having to carry around a heavy canister in an emergency).



### What to do in the event of a Fire :

There are four essential steps which has to be followed in the event of discovery of fire, which is famously known by the acronym **R.A.C.E.**



1. Rescue anyone in the immediate danger area if you can safely do so.
2. Activate the nearest fire alarm pull station to activate the building fire alarm system. The fire alarm will sound throughout the building and notify others of the need

to evacuate. As soon as a person discovers a fire, he shall immediately intimate the control room or the shift-in-charge if the fire is in the Sub-station, or to the Assistant Executive Engineer / Executive Engineer O&M if the fire is in any O&M areas, as the case may be, giving exact information regarding the location, type and event of fire. The Operator / Shift-in-charge in the control room or the concerned engineers, after receiving the message of fire hazard shall inform immediately his immediate superior officer and the nearest available local fire brigade giving the exact information regarding the location type and extent of fire.

3. Confine the fire by closing doors (do not lock) to the fire scene and securing potentially dangerous substances and/or equipment.

4. Extinguish / Evacuate - If the fire is in the incipient stage then with the aid of available first aid fire extinguishers proceed to extinguish or control the fire with proper extinguisher until help arrives.

In case of fire involving electrical apparatus, the first step is to ensure the circuit is dead. Where it is not possible to switch off the current, the fire must be tackled in a way, which will not involve danger to the person, i.e by the use of non-conducting extinguishing materials i.e Carbon di oxide, Dry Chemical Powder, dry sand etc. Water should not be used on fires involving electrical equipments.

When extinguishing a fire known to have been started through an electrical fault, the current must, in any event, shall be switched off to avoid ignition.

If it is sensed that staying in the premises will pose danger then evacuate the building by the nearest or alternate exit if possible. Do not use elevators during an evacuation! Those who are unable to evacuate the building on their own should go to a stairwell landing and wait for evacuation assistance.

### **Procedure for Operation of Fire Extinguishers :**

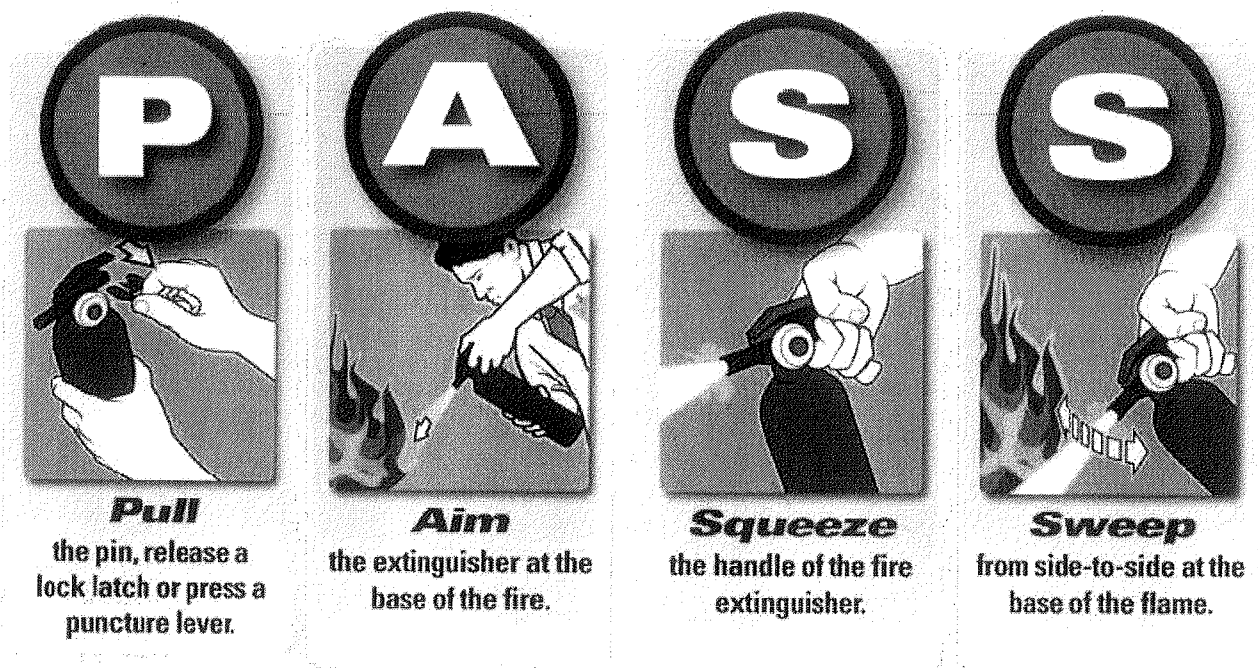
In the event of a fire before proceeding with the decision of handling the fire with available fire extinguisher the following points must be ensured.

- Is the fire small enough and contained enough that you can put it out safely?
- Is a fire extinguisher available and within easy reach?
- Is the fire extinguisher of the proper type to put out the kind of fire you want to extinguish?
- Is the extinguisher fully charged and large enough to put out the fire?
- Have you been trained to properly use a fire extinguisher?

- Can you be certain that you won't be putting yourself for others at risk if you use the fire extinguisher to fight the fire?

Once the type of fire is known and selected an appropriate fire extinguisher, the next step is to use the extinguisher to put the fire out.

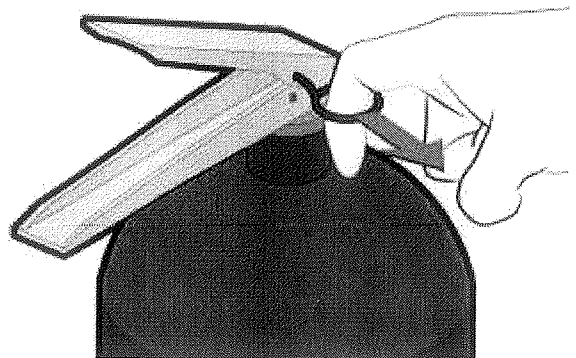
There's a simple, 4-step method which can be followed to use a fire extinguisher properly. The fire extinguisher steps method is known as PASS, and each letter in the word PASS (P, A, S, and S) stands for the first word of each step. The PASS method works for many common fire extinguishers.



### Pull:

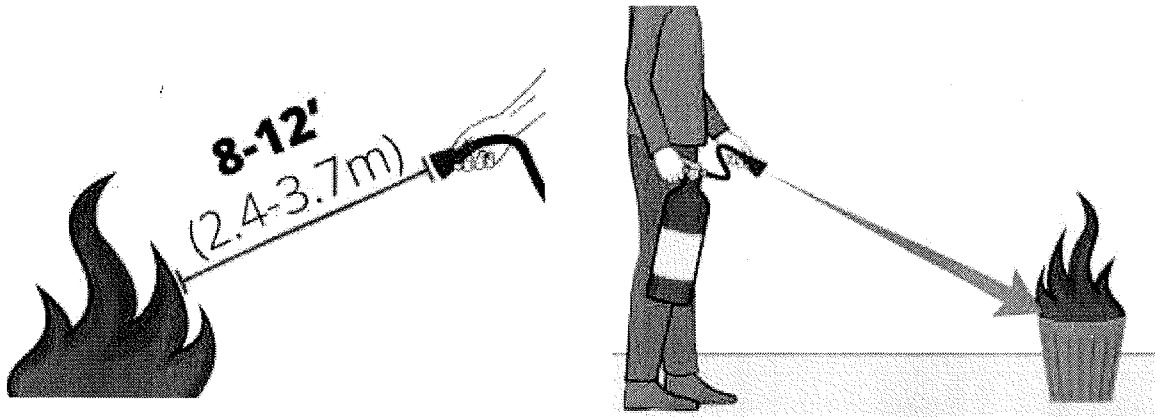
Every fire extinguisher has a pin inserted into the handle that prevents the fire extinguisher from being discharged by accident. Grab the ring and pull the pin out from the side of the handle.

Now that the extinguisher is ready to discharge, hold the device so the nozzle is pointed away from you.



## Aim:

Move to the proper distance. Many fire extinguishers have a range of between 8 and 12 feet (2.4 to 3.7 m). Before discharging the extinguisher, move toward or away from the fire so you're standing 6 to 8 feet (1.8 to 2.4 m) (1.8 to 2.4 m) away. You can move closer once you start dousing the fire and the flames die down.

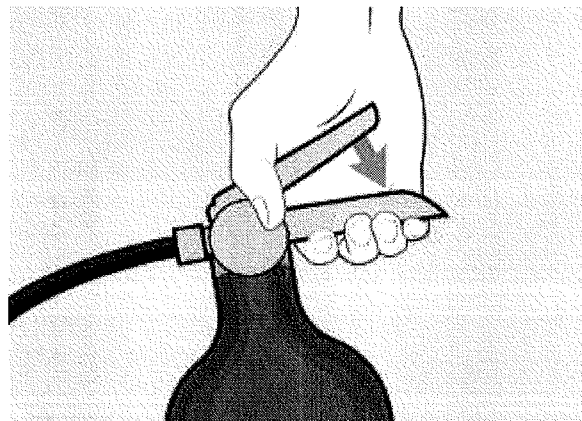


Aim the hose at the base of the fire. Hold the lower handle lever (the carrying handle) with one hand and grab the hose or nozzle with the other hand. Point the hose directly at the base of the fire, because you have to put out the fuel that's burning.

- Do not aim the hose at the flames. This isn't the fuel source, and you won't get much progress.
- With carbon dioxide extinguishers, keep your hands away from the plastic discharge horn, which gets extremely cold.

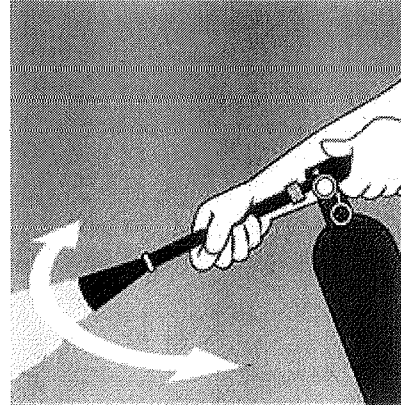
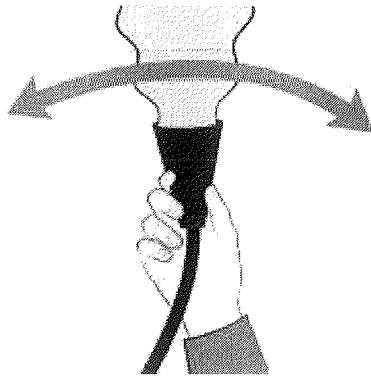
## Squeeze:

To release the extinguishing agent, squeeze the two levers together with one hand while you aim the hose at the base of the fire with the other. Apply slow and even pressure when you squeeze the levers. To stop discharging the extinguisher, release the levers.

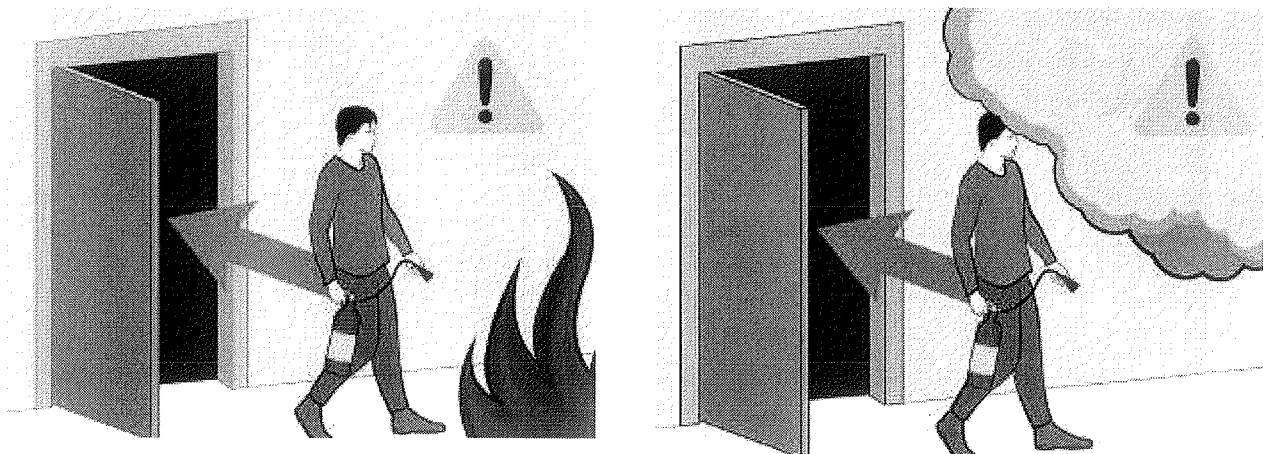


## Sweep:

Sweep the hose from side to side. To extinguish all the fuel, slowly sweep the hose back and forth over the base of the fire as you discharge the extinguisher. Move closer to the fire as the flames die down. Continue discharging until the fire goes out. This includes any glowing embers, which can reignite.



Back away and repeat if the flames flare up. Watch the fire closely to ensure the flames don't flare up again. Back away slightly if they do. Aim the hose again, squeeze the lever, and sweep the hose across the base of the fire again to extinguish it. Never turn your back on a fire. You always want to be vigilant about where the fire is and what it's doing.



**Leave immediately if you're unable to extinguish the fire.** The average extinguisher will have enough agent inside to go for about 10 to 15 seconds. Back away and leave immediately if the fire isn't out when the extinguisher is fully discharged or if you don't have any other standby extinguishers.

**Evacuate a room that's filled with smoke.** Never try to fight a fire on your own if the room is full of smoke. Smoke inhalation can lead to unconsciousness, and you'll be stuck in the room with the fire. If there is lots of smoke in the room, cover your mouth and get down on the ground. Stay low to avoid the smoke and crawl out of the room to safety.

## Recommended Quantities of First Aid Fire Extinguishers :

The number and size of fire extinguishers required for any premises is determined taking into consideration the severity of incipient fire, characteristic of different materials in the building, the rapidity with which a fire may spread etc. Accordingly the number of fire extinguishers that has to be provided in the different buildings / areas of TANGEDCO is specified below.

Sl No	Type of First Aid Fire Fighting Equipment	Norm for Provision
<b>For 110 kV Sub - Station</b>		
a.	Foam type fire extinguishers (Trolley mounted) 45 litres capacity	1 No for a bank of 3 transformers
b.	Dry Chemical powder fire extinguishers (Trolley mounted) 22.5 kg	2 Nos. for a bank of 3 transformers
c.	Dry Chemical powder fire extinguishers (Trolley mounted) 10 kg	1 No for each Circuit Breaker limited to a maximum of 3 Nos. irrespective of voltage, class, category, type etc
d.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	2 Nos. for the Control room
e.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	2 Nos. for Carrier room located separately from control room
f.	Mechanical Foam Type (Stored Pressure) fire extinguishers – 9 litres	6 Nos. for the switchyard
g.	Fire Buckets – 10 litres – Sand	2 x 4 Nos. for the switchyard
h.	Fire Buckets – 10 litres – Water	4 Nos. for battery rooms with 110/220 v batteries.
i.	Half drums filled with sand	2 Nos. for yard.
<b>66 kV and 33 KV Sub- Stations, Indoor Sub-stations (33/11KV)</b>		
a.	Dry Chemical powder fire extinguishers (Trolley mounted) 22.5 kg	2 Nos. for a bank of 3 transformers
b.	Dry Chemical powder fire extinguishers (Trolley mounted) 10 kg	1 No for each Circuit Breaker limited to a maximum of 3 Nos irrespective of voltage,



Sl No	Type of First Aid Fire Fighting Equipment	Norm for Provision
		class, category, type etc
c.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	1 No for the Control room
d.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	2 Nos. for the yard
e.	Mechanical Foam Type (Stored Pressure) fire extinguishers – 9 litres	4 Nos. for the yard
f.	Fire Buckets – 10 litres – Sand	4 Nos. for the yard
g.	Fire Buckets – 10 litres – Water	4 Nos. for battery rooms separately located.
h..	Half drums filled with sand	2 Nos. for yard.
<b>Capacitor Bank</b>		
a.	Dry Chemical powder fire extinguishers (Trolley mounted) 10 kg	1 No for each Bank of 1 MVAR or less.
<b>Indoor Sub-stations (11KV/433 V)</b>		
a.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	3 Nos. for the Control room and Transformer
b.	Fire Buckets – 10 litres – Sand	4 Nos.
<b>Offices</b>		
a.	Water Type (Stored Pressure) fire extinguishers - 9 Litres	1 for every 1000 sq. ft. area with a minimum of 2 Nos.
<b>MRT Laboratory ( Main Testing centre )</b>		
a.	CO <sub>2</sub> fire extinguishers 4.5 Kg	3 Nos
<b>MRT Laboratory ( Regional Testing centre )</b>		
a.	CO <sub>2</sub> fire extinguishers - 4.5 Kg	1 No
<b>Special Maintenance</b>		
a.	Mechanical Foam Type (Stored Pressure) fire extinguishers – 9 litres	3 Nos.

Sl No	Type of First Aid Fire Fighting Equipment	Norm for Provision
<b>Central Stores – Indoor Area</b>		
a.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	2 Nos.
b.	CO <sub>2</sub> fire extinguishers - 4.5 Kg	1 No
<b>Central Stores – Outdoor Area</b>		
a.	Water Type (Stored Pressure) fire extinguishers - 9 Litres	3 Nos.
b.	Fire Buckets – 10 litres – Sand	4 Nos.
c.	Half drums filled with sand	4 Nos.
d.	If Transformers in stock  Mechanical Foam Type (Stored Pressure) fire extinguishers – 9 litres	3 Nos.
<b>Sub Stores – Indoor Area</b>		
a.	Dry Chemical Powder (Stored Pressure) fire extinguishers - 5 kg	2 Nos.
b.	CO <sub>2</sub> fire extinguishers - 4.5 Kg	1 No
<b>Sub Stores – Outdoor Area</b>		
a.	Fire Buckets – 10 litres – Sand	3 Nos.
b.	Half drums filled with sand	2 Nos.

### **Selection of Location for Fire Extinguisher :**

When selecting locations for fire extinguishers, due consideration should be given to the nature of risk to be covered. The extinguisher should be placed in conspicuous positions and shall be readily accessible for immediate use in all parts of the occupancy.

Generally, fire extinguishers should be placed as near as possible to exits or stair lands without hindering the escape routes. It should be placed in such a way that these shall readily be seen by persons following the natural impulse to get out of danger.

The extinguishers should be available for immediate use at all times. It should be sited in such a way that the user may not have to travel more than 15 m from the site of the fire to reach the extinguishers. Similar position on each floor are advisable.

When installed in a building, the extinguisher should not be placed in a position where it is likely gain heat from the surrounding equipment, process or direct Sun rays.

### **Inspection & Maintenance of Fire Extinguisher :**

Periodic inspection of fire extinguishers shall include a check of at least the following items.

- Location in designated place.
- No obstruction to access or visibility
- Operating instruction and nameplate legible and facing outward.
- Safety seals and tamper indicators not broken or missing.
- Fullness determined by weighing or lifting.
- Examination of obvious physical damage, corrosion, leakage or clogged nozzle.
- Pressure gauge reading or indicator in the operable range or position and
- Condition of tyre, wheels, carriage, hose and nozzle checked (for wheeled units)

The fire extinguishers must be maintained periodically as specified in the **Indian Standard IS 2190 (2010) : Selection, Installation and Maintenance of First-Aid Fire Extinguishers – Code of Practice**. Also all the fire extinguishers must be procured, maintained and operated as specified in the Indian Standards stated below.

- IS 6234:2003 – Portable fire extinguishers, water type (Stored Pressure) – Specification (First revision).
- IS 15397 : 2003 – Portable fire extinguisher mechanical foam type (Stored Pressure) –Specification.
- IS 13849, 4308 – Portable fire extinguisher Dry Chemical Powder type (Stored Pressure) –Specification.
- IS 10658 – Specification for higher capacity Dry Chemical Powder type fire extinguisher (Trolley mounted).
- IS 2878 – Portable fire extinguisher CO<sub>2</sub> –Specification.

## CHAPTER - 11

### FIRST AID

First aid is simple medical treatment given as soon as possible to a person who is injured or who suddenly becomes ill. This is usually effected by a lay person and performed within a limited skill range. First aid is normally performed until the injury or illness is satisfactorily dealt with or until the next level of care, such as a paramedic or doctor, arrives. First aid may help the person to survive till the doctor comes and saves his/her life.

The key guiding principles and purpose of first aid which govern all the actions undertaken by a first aider is.

- Prevent further injury
- Preserve life
- Promote recovery

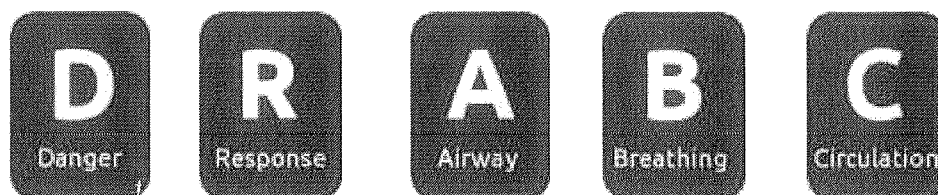
In order to provide safe and effective assistance at the scene of an emergency working in a logical and planned manner is essential. Depending on the situation it may be needed to send for emergency help before going near the scene.

In the event of an accident the initial steps which has to be taken are

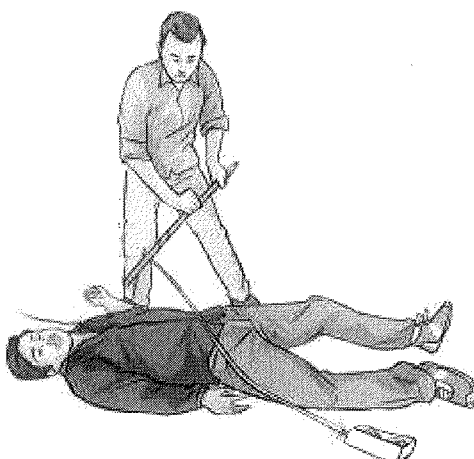
- Turn off the source of electricity, if possible. If not, move the source away from you and the person, using a dry, non conducting object made of cardboard, plastic or wood.
- Keep the affected person lying down in a comfortable position, his head in level with his body. This will prevent him against fainting.
- Severe Hemorrhage (Blood Loss) must receive immediate attention, no matter what other injuries are present.
- If the Breathing is ceased, immediate measures must be taken to restore it. The victim should be in a position to breath freely. Breathing supply Oxygen which is essential for life. Oxygen is circulated throughout the body by Blood. If Oxygen does not get in to the brain for more than about Three Minutes, brain tissues begins to die. Hence breathing must be restored immediately.
- When the Victim has fractured bone, no attempts must be made to move him until the bone has been made immovable.

- Never give water or liquid to an unconscious patient.

Once the incident is under our control then need to think about handling of the casualty. The steps involved in handling of the casualty is famously known by the acronym **DRABC**.



**D – Danger.** Your priority when you are trying to help someone in a situation should always be to remain safe and avoid causing any injury to yourself or others. Look and listen for signs of potential risks before you start to treat the unconscious person. If the area isn't safe, move away from the danger and call 108 or 101 (Fire Service).



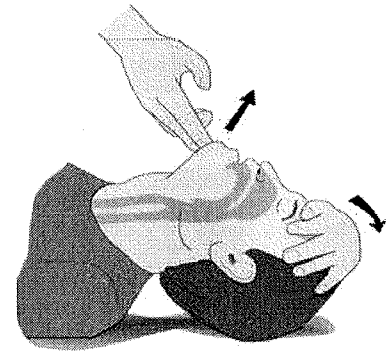
**R – Response.** You now need to assess how responsive the casualty is and if they are conscious. The first step in this stage is to loudly ask a simple question, such as “Hello, can you hear me?” If they answer clearly, then they are alert and you can move straight on to the last stage of the action (Circulation).

If they don't respond verbally, try asking another question in a loud voice close to their ear, such as “Can you open your eyes?” If there isn't any movement of the eyelids, then give them a firm pinch on both shoulders. If the casualty isn't alert, this generally indicates that the person needs immediate medical attention, so an ambulance should be called.

If the casualty is unresponsive to your voice, or a firm pat or a pinch on the shoulder, then they are unconscious. If there are other people present, tell one of them to ring for an ambulance. If there isn't anyone to help you, shout for assistance as loud as you can.

**A – Airway.** In order for the casualty to breathe, they need to have a clear airway. If they are unconscious, the tongue can become floppy and fall to the back of the throat, blocking the airway.

The airway can be opened by placing two fingers under their chin and your other hand on their forehead. You then gently tilt the head back and lift the chin. While the casualty's head is in this tilted position, their tongue will be away from the back of their throat. The head will need to be held in this position, so keep your hands on the forehead and the chin, or enlist a bystander to help.



Also it has to be checked for the presence of any foreign substance in the mouth which may obstruct the airway. If any foreign substance is present then it has to be removed by tilting the head sideways

**B- Breathing.** Once the airway is clear you need to establish if your casualty is breathing normally. The easiest way to check this is to lower your head to the level of their face and look down their body, from their head to their feet.

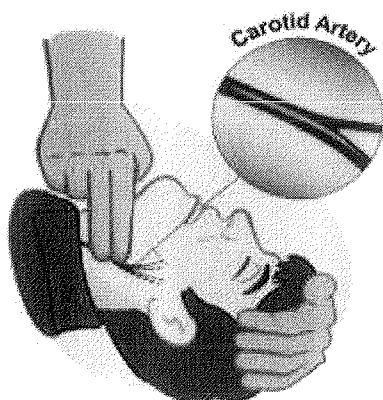


In this position you will be able to see if their chest is rising and falling, while listening for breathing and seeing if you can feel the movement of their breath on your cheek. You should hold this position for not more than ten seconds.

If your casualty is unconscious, but breathing normally, you can move on to the final step – circulation. If the casualty is unconscious and not breathing you should immediately start cardiopulmonary resuscitation (CPR). It's important to only move on to the next stage when you are sure that the casualty is breathing normally. No time should be wasted in starting CPR.

**C- Circulation.** Once you have checked that the casualty's airway is clear and they are breathing normally we have ensure the circulation of the blood by checking the pulse. In case of emergencies to check for the hear beat, Carotid Pulse has to checked. This pulse can be felt by placing the finger tips gently on the voice box and sliding them down into the

hollow between the voice box and the adjoining muscle. The normal pulse rate per minute on an average is 72. Count the pulse rate for 10 seconds, if it is other than 12 to 14, it may be abnormal.



Once circulation is confirmed then we need to look for signs of major blood loss. If there is any external bleeding, apply pressure to the area and if the bleeding is from a limb, raise the affected arm or leg above the level of the heart.

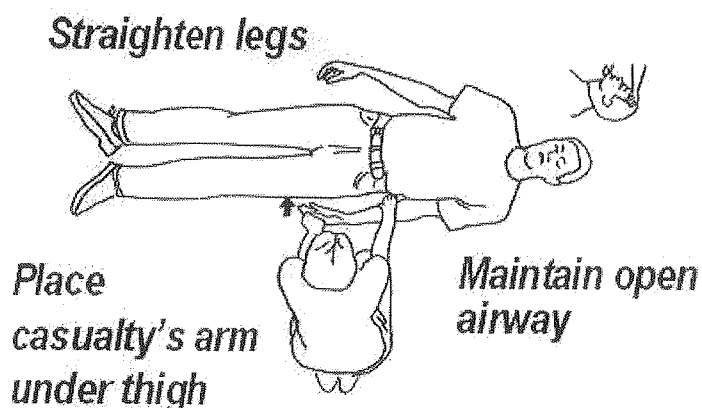
Injuries or conditions that result in severe bleeding, internally or externally, can be life threatening because of the risk of shock. It's possible that the casualty may have internal bleeding, so the casualty should be monitored for signs of shock.

If the unconscious person is breathing normally and is showing no signs of severe bleeding or shock, then all you need to do is keep their airway open by placing them in the recovery position.

### The Recovery Position

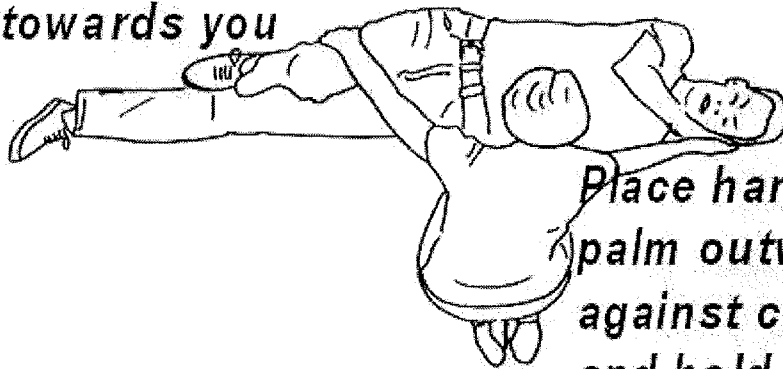
A person who is unconscious is at risk from dying because of a blocked airway. In most cases turning the casualty into the recovery position can prevent this. Before turning the casualty in to the recovery position, remember to carryout the appropriate steps in DRABC. The steps involved in brining the victim into recovery position is.

#### Step -1



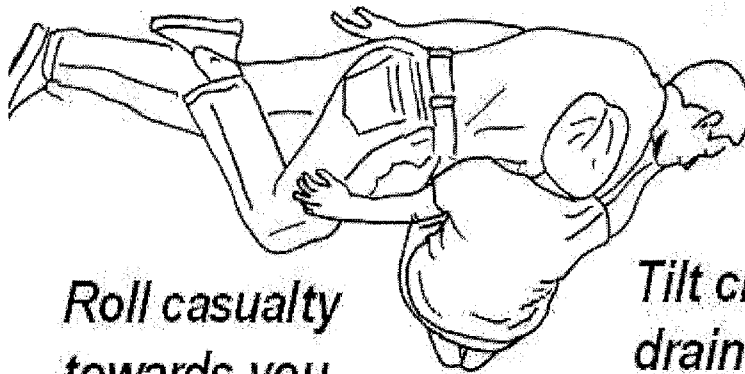
Step - 2

**Pull far leg  
towards you**



**Place hand -  
palm outwards  
against cheek,  
and hold it there**

Step - 3

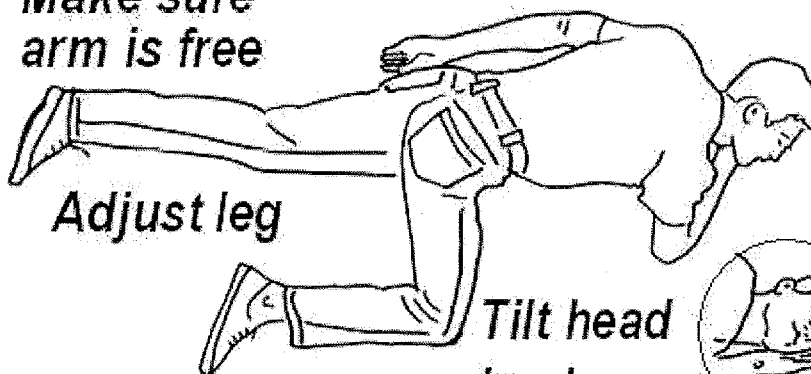


**Roll casualty  
towards you**

**Tilt chin to  
drain  
mouth**

Step - 3

**Make sure  
arm is free**



**Adjust leg**

**Tilt head  
back**





## **FIRST AID FOR ELECTRIC SHOCK :**

An electric shock occurs when a person comes into contact with an electrical energy source. Electrical energy flows through a portion of the body causing a shock.

The danger from an electrical shock depends on the type of current, how high the voltage is, how the current travelled through the body, the person's overall health and how quickly the person is treated.

An electrical shock may cause burns, or it may leave no visible mark on the skin. In either case, an electrical current passing through the body can cause internal damage, cardiac arrest or other injury. Under certain circumstances, even a small amount of electricity can be fatal.

A person who has suffered an electric shock may have very little external evidence of injury or may have obvious severe burns. Burns are usually most severe at the points of contact with the electrical source and the ground. The hands, heels, and head are common points of contact.

In addition to burns, other injuries are possible if the person has been thrown clear of the electrical source by forceful muscular contraction. Consideration should be given to the possibility of a spinal injury. The person may have internal injuries especially if he or she is experiencing shortness of breath, chest pain, or abdominal pain. Pain in a hand or foot or a deformity of a part of the body may indicate a possible broken bone resulting from the electric shock causing violent muscle contraction.

Affected individuals should be examined for entry and exit marks to help determine the extent of the electric shock. Some individuals may suffer a cardiac arrest after electric shock (they may not have a pulse or be breathing).

If an individual is unconscious, not breathing and with no pulse after an electric shock it may be a Cardiac Arrest, immediately start with Cardio Pulmonary Resuscitation (CPR). The procedure for CPR is stated below.

### **Cardiopulmonary resuscitation (CPR)**

Cardiopulmonary resuscitation (CPR) consists of the use of chest compressions and artificial ventilation to maintain circulatory flow and oxygenation during cardiac arrest

In October 2010 the procedure / guidelines for performing CPR has been revised within an objective to make it easier for rescuer and health care providers alike to learn, remember and perform better CPR. New CPR guidelines advises to go for Chest Compressions immediately, instead of opening the victim's airway and breathing into their mouth first. The sequence in Revised CPR is

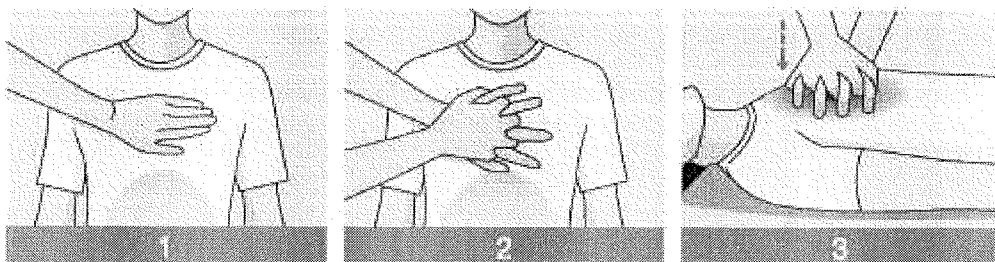
### **STEP – 1 :Begin Chest Compressions**

If the victim is not breathing, place the heel of your hand in the middle of his chest. Put your other hand on top of the first with your fingers interlaced. Compress the chest at least 2 inches (4 – 5 Cm). Allow the chest to completely recoil before the next compression, relaxing the pressure on the chest between compressions allow the heart to refill

and pump more blood. Compress the chest at a rate of at least 100 pushes per minute. Perform 30 compression at this rate.



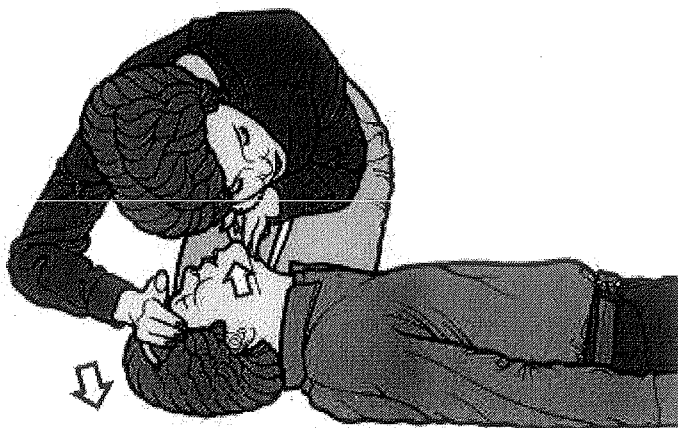
### Proper Techniques for Chest Compressions.



If you are not trained in CPR, continue to do chest compressions until help arrives or the victim wakes up. Its normal to feel pops and snaps when you first begin chest compression – **DON'T STOP !!**you're not going to make the victim worse.

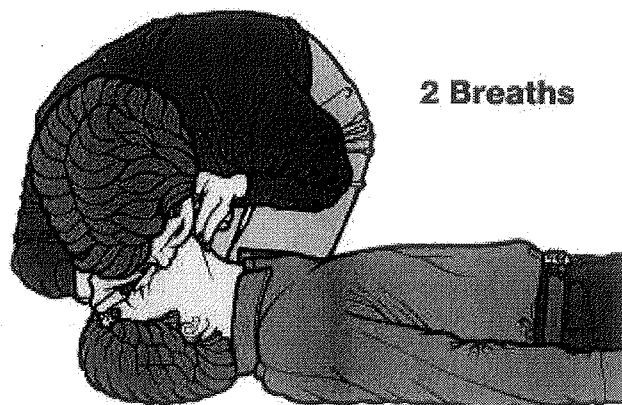
## **STEP - 2 : Open the Airway.**

After 30 compressions, open the victim's airway using the head-tilt, chin-lift method. Pinch the victim's nose and make a seal over the victim's mouth with yours. (use a cpr mask if available).



## **STEP - 3 : Begin rescue breaths.**

Give the victim a breath, just enough to make the chest rise, Let the chest fall, then repeat the rescue breath once more.. If the chest doesn't rise on the first breath, reposition the head and try again. Whether it works on the second try or not, go to step4.



## **STEP - 4 : Repeat Chest Compressions.**

Repeat chest compressions. Do 30 more chest compressions just like you did the first time.

## **STEP - 5 : Repeat Rescue breaths.**

Repeat rescue breaths. Give more breaths just like you did in step 3 (unless you're skipping the rescue breaths). Repeat steps 4 and 5 for about two minutes ( about 5 cycles of 30 compressions and 2 rescue breaths). This can be continued till medical help arrives or the victim wakes up.

## CHAPTER - 12

### ACCIDENT REPORTING AND AUDITING

#### Why Reporting Necessary?

- We ought to try our best to learn from the experience of others, rather than to learn the hard way and we must pass on to the generation a record of what we have learnt.
- Critical review and recommended measures to avoid recurrence of such accidents could be possible only on reporting of accidents.
- From the point of elimination, causes (un safe conditions and unsafe actions) could be analyzed so as to issue circulars to promote safety consciousness and awareness among the field staff.
- In short reporting is basically needed to minimize the accident rate by way of deep study as to inculcate safety mind among the staff.
- To reduce the compensation loss towards accidents (met by the organization)

Notice of accidents and inquiries is mandated by Electricity Act 2003 vide section 161(1) as follows:-

If any accident occurs in connection with generation, Transmission, distribution, Supply or use of electricity in or in connection with, any part of electric lines or electrical plant of any person and the accident results or likely to have resulted in loss of human or animal life or in any injury to a human being or an animal, such person shall give notice of the occurrence and any of such loss or injury actually caused by the accident, in such form and within such time to the EI and other authorities.

The power conferred by 180 (1) and 180 (2) read with 161(1) of the Act, State Government has made "Tamil Nadu – Intimations of Accidents (Form and Time of Notice) Rules 2009" vide G.O.Ms.No.42 dated 05.06.2009.

#### Investigating the Accident Spot :

- All fatal accidents departmental and non - departmental other than due to bonafide cases of suicide, Inquisitive climbing etc, should be investigated by Executive Engineers concerned.
- Bonafide cases of suicide of inquisitive climbing fatal accident and all serious non - fatal accidents to both departmental and non - departmental persons should be personally Investigate by AEEs concerned.
- Non - fatal accidents of minor nature may be investigated by the section officer concerned.

- All human fatal accidents to departmental and non- departmental persons should be personally investigated by concerned Superintending Engineers of the circle.
- All accidents of electrical nature should be investigated by the Electrical Inspector concerned.
- All departmental and non - departmental accidents in connection with TANGEDCO in the region area should be investigated by the Safety Engineer.
- If departmental electrical accident occurred the investigation officer at the accident spot should acquire the Line Clear book used for the work undertaken in the site.
- Exhibits to be examined and taken as evidence by the investigating officer.
- In case of electrical accidents a neat sketch showing the site of accident with all details, of electrical accidents along with electrical layout of the site should also be furnished.

#### **Intimation of Accidents and Reports :-**

If any accident occurs in connection with electricity in connection with any part of electric line or other works of any person of the accident results in or likely to have resulted in loss of human or animal life or in any injury to a human being or an animal

- The accidents as and when occurred shall be intimated to Chairman's office by the territorial EE concerned immediately after inspection of site by e-mail / SMS and ensure the same has been received.
- The preliminary report shall be submitted on the same day of the knowledge of occurrence of the accidents and in any case within 24 hrs of such the knowledge of occurrence by the EEs and an interim report from SEs within 48 hours.
- The detailed report shall be submitted within 7 days from the date of occurrence of the accident by the SE / EDC concerned
- The Chief Engineers shall critically review the accidents and furnish their reports upon receipt of detailed report from SEs /EDC
- Copies of all the reports shall be sent to SE / Chairman's Office. CE / Personnel, CE / Planning &RC, SE / RE&I(D), Director Distribution.
- Action taken on staff responsible, DPs to be initiated and punishment given etc. should be reported to CE/ Personnel within two months.

**Details to be accompanied with report:**

- Victims doing just prior to the accident and at the moment of accident.
- Cause of the accident
- Manner in which accident occurred.
- The nature of injury suffered
- Action taken by the witnesses, co - workers or supervisory staff (first aid, medical facilities extended and steps taken to remove the cause of accident.
- Current status of the victim at the time of reporting

Enclosures should be accompanied with the report :

- Statement of persons who met non – fatal accident.
- F.I.R. or social work register acknowledgement from police official
- Post - mortem or medical certificate from the concerned medical authority.
- Statement of persons assisting the person who lost life or injured / Supervisory staff statements.
- Neat Layout showing the accident spot.
- Witness Statement.
- Any other material relevant to the incident.

( All the forms Related to Accident Reporting is in Annexure – III of this manual )

**SAFETY AUDIT**

- The Prime purpose of safety Audit is to identify risk and eliminate scopes of Accidents.
- One way to ensure safety is by conducting regular safety audits.
- The safety Audit involves finding out the possible reasons and preventive measures for an accident.
- It involves verification of works carried out in the field / SS and analysis as to whether the safety standards and regulations are adhered properly by the workmen and properly exercised by the concerned supervisors.
- For effective safety Audit, a committee comprising of the following members from the Distribution Circle shall be formed by the Superintending Engineer.
  1. An Executive Engineer from the Circle.
  2. An Assistant Executive Engineer
  3. An Assistant Engineer/ Junior Engineer I Gr.

4. A special Gr. Foreman / Foreman I Grade.

- If A Safety officer of Assistant Executive Engineer / Assistant Engineer is posted to the Circle, then they may be nominated instead of SI. No (2) or(3).
- The above committee will be for a period of 12 months and after 12 months the members may be nominated afresh in the same cadre as above
- The above committee shall inspect the work locations randomly and surprisingly in any section of the Circle
- The Committee shall investigate the work with respect to safety aspects viz, Whether allocation has been made on the job allocation register, LCP availed or blink obtained / switch opened / earthing done / PPEs used or not.
- The facts and shortcomings if any shall be recorded in the format in triplicate and serve one copy of the same to the Supervisor or workmen under whose supervision the work is being carried out.
- The 2<sup>nd</sup> copy will be submitted to the Superintending Engineer concerned within 5 working days from the Audit
- Depending on the degree of severity of the non- compliance of safety procedures necessary action shall be taken on the erring supervisor and / or workmen as deemed fit.
- The committee shall inspect at least 12 locations in a year.
- If the same deficiency is found repeated for another time the punishment shall be severe.
- If during the time of inspection the working team is adhering Safety rules / regulations in an excellent manner, then appreciation may also be given.
- Concerned Superintending Engineer shall take appropriate action to disseminate the information on the formation of Safety Audit Committee to the down level with the reward / punishment system.
- The activities of the Safety audit committee shall be reviewed periodically by the Superintending Engineer Concerned.

**(Form Related to Safety Audit is in Annexure – IV of this manual )**

## CHAPETER - 13

### LINE CLEAR PERMIT

- Line clear are permits issued for working on lines or equipments which are in service but disconnected from supply for carrying out any work. They should be in the form prescribed for this purpose.
- Even when the line or equipment is out of service due to defect / under breakdown, before attending breakdown or rectifications of equipment, line clear shall be obtained by the person who is going to rectify and he should be authorized to do that work.
- Every Line clear permit shall be issued by an employee authorized by the competent authority. And also every line clear permit shall be issued to a person authorized to avail the line clear.
- Every working team should have an individual line clear issued from the authorized person.
- Under no circumstance work shall be done by one team taking approval from another team who has received line clear.
- More than one Line clear can be issued on the same line or equipment for different persons.
- Generally not more than one line clear shall be issued to a single person at one time. Only after return of the previous line clear availed by him / her, the next line clear shall be issued to the same person. However under unavoidable circumstances when a second Line clear is required it may be issued to the same person subject to the condition that the safety of the working personnel is ensured properly and the entire responsibility lies with the receiver of the Line clear.
- The employee/competent person authorized to issue LC shall carryout the Operations first viz, tripping of breaker, opening of isolator, providing of earth etc, and then write the LC to issue it and this should not be done in the reverse.
- The employee who has availed line clear shall not leave during entire duration of the breakdown / rectification work spot, it is his responsibility to continuously supervise and take care of the entire persons who are engaged in the work.
- The same person who took the line clear should return it and this procedure must be followed even when receiver and issuer happen to be the same.



- No employee shall climb a pole or attempt to work in apparatus in service or in proximity to a line conductor unless the man in charge of work has obtained authorized permit for work with LC, specifically instructing him to carry out the work.
- Until discharged and earthed every conductor is considered live.

Special cases:

- When an authorized person who has taken a Line clear for the work on a line or equipment is to leave the place of work, due to emergency he should arrange another authorized person to take another line clear for the very same work and there after return this line clear and then only leave the spot. The reason for return of LC shall be specifically mentioned and recorded.
- No column in the LC shall be left blank.
- In case if the original line clear permit is misplaced due to extreme circumstances the person who received the line clear shall report the same in writing to the issuing authority and give an undertaking to the effect that the line / equipment is free and safe for energisation and all the working staff have returned from work spot and physically verified by him.. This shall not be entertained often and such incidents shall be allowed as a special case only after getting concurrence from the competent authority only.

SELF LINE CLEAR

- Where the person to work is the same as the person to open the switches, to isolate the line or equipment, then he himself shall issue and receive a self-line clear in writing and follow the same procedure while returning the self-line clear
- The Officers in charge shall verify randomly whether Self LC has been availed in the above circumstances and records maintained properly.
- In LT Distribution network also the person who is authorized to work on the network shall mandatorily follow the self LC without fail.

LINE CLEARBOOKS

- Line clear permit books shall be treated as important records.
- The books and sheets should be serially numbered 14(5)
- A separate file shall be maintained for the returned & cancelled Line clear permits.

- Duplicate copies shall be taken with carbon paper only.
- If any leaf of the LC book is inadvertently detached /found torn out, that should be accompanied with a statement recorded with dated initials of the person responsible for maintenance of such records.
- The LC book shall be reviewed periodically by the in charge. 14(5)
- No Page should be detached or used for any other purpose.

#### OBTAINING LINE CLEAR OVER PHONE

- During certain occasions when it is not possible for an authorized person to avail line clear in person, on such circumstances Line clear may be issued over phone.
- For this First of all the person who is in need of LC shall call the Substation and inform about the requirement and the phone No. from which he is calling.
- Then the shift in charge shall call the above phone No. and proceed for issue of LC.
- In such cases the content of the messages shall be repeated by the person who received request for the line clear and shall be confirmed by the sender of the message who requested the Line Clear to ensure that both parties are quite clear. The fact that the message was repeated and confirmed shall be recorded in the LCP Books by the sender & receiver respectively. Both the sender & receiver shall be authorized persons and they should be able to recognize each other's voice for issue & receipt of Line clear permit. The Phone No. from which each person was speaking should be recorded by the other.
- Issue of LC & getting LC Over phone shall not be a routine practice and shall be exercised only on emergency and un avoidable circumstances
- If the receiver is not an identifiable person then the issuer may ask for an authorization from the Officer concerned for identification and also for his phone No.
- Duplicate copy of the LC shall be sent for record at either end after duly cancelling the same.

#### AUTHORIZED PERSONS

- Any work in the TANGEDCO which involves handling of live Electrical equipments, lines etc, shall be taken up only when the person attempting the work / entrusted to carry out the work has the authorization in this regard either by virtue of holding the post or by specific authorization. The level of authorization based on designation is tabulated below.

Sl.No	Designation	Network on which authorized to avail Line clear permit	Remarks (Requirement of specific authorization if any)
1	Junior Engineer Gr-II	on HV system only (up to and including 33 KV only inside the Substation premises)	by virtue of their designation. They may avail LCP on EHV system only on specific authorization from the competent authority.
2	Spl. Gr Foreman/ Foreman/ Line Inspector	on HV system only 33KV/22KV/11KV	by virtue of their designation subject to their jurisdiction only
3	Wireman	on 22KV,11KV, MV& LV system.	For availing LCP on HV system of 33 KV special authorization to be obtained based on his level of competency limited to specific case
4	Field Assistant	For operation of HV system only.(Opening & Closing of AB switches only). LCP can be availed on MV / LV system only	By virtue of his / her designation.

- All Level of the above Authorized person should be conversant with safety precautions / procedures / Regulations and network configuration / location of switches / back feeding points etc. pertaining to their area of Jurisdiction.
- The competent Authority may cancel the authorization in case if the above requirements are not complied with.
- The revocation may be made after satisfactory compliance is ensured by the Authority concerned.
- A list containing the names and other details of the officers / staff who are authorized to issue / get LCP on the apparatus, lines and cables should be displayed at an opt location in the substation as per Regulation 16 (3) (h) of Distribution code of TNERC.

The following works should be carried out only by the Authorized persons.

- 1) Issue / receipt of line clear on lines /equipments.
- 2) Discharging / Earthing of equipments /lines.
- 3) Operation of AB switches & Isolators when they are in service and with supply.
- 4) Providing / renewal of HG fuses in the HT side of Distribution Transformer.
- 5) Carrying out the following type of works in the lines / equipments of which the voltage does not exceed 650V.
  - a) Replacing streetlights.
  - b) Renewal of fuses on poles / LT side of distribution transformer.
- 6) Testing of consumer's installation and giving service connection on LT side.
- 7) Connecting / repairing of Electrical motors, time switches etc on LT side.
- 8) Operation, maintenance, testing & supervision of works on Electrical lines /equipments.
- 9) Fuse off calls.
- 10) Replacement of meters
- 11) Shifting of Service connections
- 12) Replacement of Service wires
- 13) Shifting / deviation of lines.

**Note: Line clear must be issued by the person on whose control the lines / equipments are available.**

- Many HT lines are feeding more than one sections when such lines are declared as breakdown, the opening of the sectionalizing switches towards the next section will be done by the authorized person of 1<sup>st</sup> section and closing of the switch should be done by authorized person of the 2<sup>nd</sup> section only. The opening & closing of the sectionalizing switches shall be with the concurrence of the section officer concerned in normal cases, and the opening & closing shall be informed to the concerned section officer after having done so, in case of emergencies like Breakdowns, accidents, natural calamities etc..

### **Special Authorization**

Where ever persons of lower rank have to perform the duties not authorized to him, special authorization may be given by the Executive Engineer of the Division, on the basis of proper recommendation by the concerned officer based on his / her competency level.

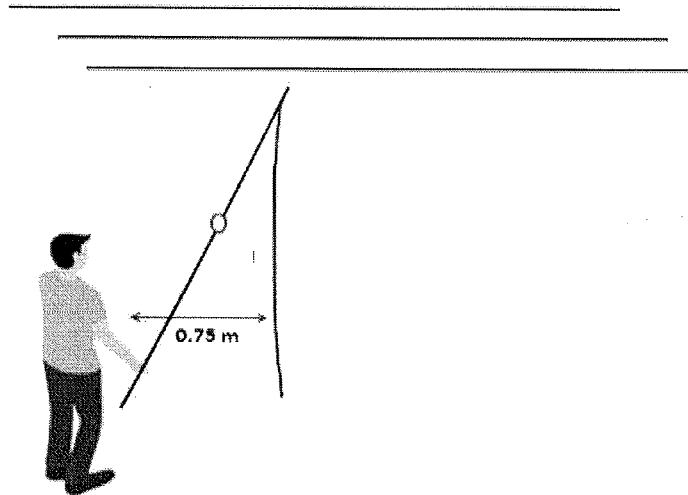
Before consideration for special authorization, the following should be taken in to account.

- 1) The reason for giving special authorization should be justifiable.
- 2) The person for whom the special authorization is to be given should have adequate knowledge to carry out the work conversant with the location / network of the work spot and should have sufficient experience.
- 3) The special authorization should be for a particular person and not for the post. Further it is valid for a particular period only after which it has to be revalidated.
- 4) The special authorization should indicate the area of work distinctly.
- 5) The person should be well acquainted with the feeding arrangements in that area.
- 6) In accordance with the CEA regulations, it should be ensured by the authorizing officers that all the authorized persons are acquainted with and competent to apply the instructions regarding treatment of Electric shock and all the methods of Artificial respiration system.

**Procedure for issue of line clear :**

- 1) Line clear should be issued by authorized person to the authorized person only to receive it.
- 2) Line Clear must be issued only upon receipt of prescribed Line clear application in complete shape. ( **Format of application specified in Annexure – 1** )
- 3) Before issue of line clear:
  - a. Specific approval from the competent authority to carry out normal scheduled works should be obtained
  - b. For emergency nature, the same shall be informed to the competent authority.
  - c. Even though prior approval for scheduled work is available, the LC shall be issued only based on the condition prevailing on the particular time/day of work.
  - d. The equipment or line shall be isolated from the supply and it should be ensured that there is no back feeding on the equipment /line.
  - e. The person issuing line clear shall personally ensure that only the concerned AB switch / breaker is opened for which the LC is sought for.
  - f. The person issuing the line clear shall personally see that the isolator or AB switch blades are opened fully. They shall be locked in the open position or in "OFF" position.
  - g. After personally confirming the switch is in OFF condition, and after putting the key in the Line clear board for safe custody, then every one of the conductors or the respective equipment shall be tested for voltage or charge by a discharge rod. The discharge wires shall be kept at least 0.75 meters away from the person doing the

work of discharge.



- h. Then all the conductors be shorted together and effectively earthed on the outgoing side of the switch / isolator. Using of Rubber gloves or gauntlets shall be mandatory for discharging and earthing.
- i. While issuing LC on Lines, generally earthing is made on Line side and the earthing leads are connected to the earths available inside the Substation premises which will be connected to Earth mats. But to avoid appearance of dangerous voltage due to Transfer potential, the receiver of the LC must be advised to provide earths compulsorily at the work spot and it shall be clearly mentioned in the LC.
- j.
- k. Caution board as "Men on line" "Do not switch on" to be placed on the isolator.



- l. All operation in connection with the issue of line clear should be done by the person issuing LC or under his immediate presence on the site and as per his / her directions only.

- m. After the above operation are carried out. The line clear form shall be filled up correctly without corrections. And no column in the form shall be left blank. Corrections / over writing should be attested with dated initials and No of corrections / over writings should be indicated specifically. Both the issuer and receiver shall sign in the LC with date & time in the appropriate places.

**Procedure to be followed for Receiving of Line clear :**

- 1) Any person requiring a line clear on any line or equipment shall apply in writing to the competent authority, specifying clearly the portion of line / equipment, where supply to be cut off and nature of work to be carried out.
- 2) When line clear is taken in person, the employee taking the line clear should follow the employee doing the isolation discharging etc. and confirm himself as far as his knowledge goes that the equipment on which he has to work is isolated from the mains on either side as seen visually and is discharged before he acknowledges and accepts the Line clear. Then only he shall sign in the LC permit form
- 3) He shall follow the operations carried out by the official issuing LC and ensure that isolation, discharging, earthing etc, are properly carried out. Then only he shall sign in the permit form except LC over phone.
- 4) At the work spot, he shall test the line or the equipment on which he has received the LC permit, with discharge rod and then earthing shall be done on either side of the work spot effectively.
- 5) If the work on a line/ equipment involves the possibility of the line / equipment coming in to contact with the other line / equipment, or crossing the line a separate line clear must be taken on those lines / equipments from the person who is competent to issue line clear on those line /equipments.
- 6) The person who has availed the line clear shall record on the line clear form, the No of persons who are attending the work. Then only he should begin the work.

To start with the work, the following are to be observed.

- 1) Identification of permitted areas.
- 2) Identification of danger zones.
- 3) Test for back feeding.

### **Identification of permitted area:**

Caution boards like MEN ON LINE; DANGER UNDER LC, etc., to be placed on the breakers / switches to identify the permitted area.

### **Identification of danger zones:**

When the adjacent equipment to the permitted zone is live, then a rope around the live equipments shall be belted with 1 inch manila rope 3 feet from ground level and on which a red flag with cotton shall be tied to identify the danger zone.

The top of ladders to be used shall be tied on the equipment where LC has been issued, to prevent men from getting up live equipments by mistake.

### **Return of line clear .**

The following are to be observed on return of line clear.

- 1) The authorized person who received the LC only shall return it.
- 2) He should personally ensure that all earth rods used for work were removed
- 3) He shall personally see that all men have returned from work and the line, equipment etc are free from men, materials and any earthing devices or shorting devices etc. Further it shall be ensured that the works carried out are completely satisfactory to the point of normal operating condition and it will not affect or alter the routine system. If at all any change had to be made then it shall be informed to the section officer and others concerned.
- 4) All the men working shall be informed by the person who has availed the LCP that the line clear permit is being returned and they must be made to understand that working in the above line / equipment will no longer be admitted and not safe for work.
- 5) The equipment / line shall not be charged until all the line clear permits are duly cancelled.

**The following rules shall be adhered to when a line clear is returned before charging the line /equipment.**

- 1) The returned LC shall be examined and ensured that all the necessary certificates are furnished for the entire satisfaction of the operating person.
- 2) "Caution Boards" shall be removed from the equipment / switch controlling the lines.
- 3) It should be ensured that there is no other LC is pending to be returned on the particular equipment / line.
- 4) The earth rods shall be removed at supply point
- 5) It shall be examined at the supply point for men material & earth, and that may be removed and then only the line shall be energized.



- 6) Following shall be checked
  - 6.1) The condition is same as before the issue of LC.
  - 6.2) Equal voltage on the equipment /line
  - 6.3) Any Unusual noise is heard.
7. The fact shall be informed to the person who has availed the LC.
8. After the line / equipment is energized and normal operating condition is restored, then only the members who worked on the LC shall leave the place.

### **RECEIPT OF BLINK**

- BLINK is intended for carrying out Switching Operations only and not a permit to work
- The receiver of the BLINK shall be authorized by the section Officer concerned.
- The section Officer either by a written message or by phone request for a BLINK on a particular feeder
- If it is by phone an OTP may be sent to the Section officer by the Operator and the OTP shall be communicated by the Section Officer to the Operator so that the blink will be issued
- In case the Blink is authorized to some staff in that Section then the OTP may be sent to that staff on request by the Section Officer.
- On receipt of the OTP the staff authorized may contact the Operator of the SS and telling the OTP received to the operator and request for a blink.
- The receiver shall clearly communicate the exact feeder on which the blink is required and duration of the blink. At any case the blink shall not exceed 15minutes.
- After switching operation is over, the receiver of the blink will contact the Operator to normalize the feeder,
- Again to check the identity, the operator shall send OTP to the number from where the blink is obtained.
- After receipt of OTP the receiver of the blink can inform the OTP to the operator and then only the feeder will be normalized.
- At no case the operator shall not energise the feeder unless there is a communication is received from the receiver of the blink.

## CHAPTER-14

### SAFETY TRAINING & AWARENESS

As per CEA regulations on measures relating to safety, training to all those who are engaged in Generation / Transmission / Sub transmission / Distribution shall be given training. The periodicity of Training shall be as follows.

SL.NO	LEVEL	PERIODICITY	OFFICER RESPONSIBLE
1	SECTION	Every month for 1 hr duration	Section Officer
2	SUB-DIVISION	Every Quarter for 1 ½ hrs duration apart from Section level	Sub-division Officer
3	DIVISION	Every Half year for 2 hrs duration, apart from Section & Sub division level	Executive Engineer
4	CIRCLE	Annual for 3 hrs duration, apart from other levels	Superintending Engineer

- A separate register shall be maintained for the above. Necessary expenditure shall be incurred by the Officers concerned under proper sanction by the competent authority.

#### Topics to be discussed in the above safety training programme

- Basic principle of safety, importance of safety Rules and their observation
- List of safety equipment (PPEs), their proper use and maintenance thereof, how it protects etc.
- LC procedures
- Self LC, LC over phone, and procedure to be observed as per safety manual & CEA regulations
- Electric shock and safety, First Aid
- Causes of accident, precautions to be taken to avoid accidents while working.
- Case studies

#### Additional Topics for Sub-Stations

- Fire fighting
- Principle and causes of fire, class of fire, ABC, precautions to be taken to avoid fire.
- Firefighting equipment, their type and use, their periodical maintenance.

During the above programmes, typical case studies, recent accidents and preventive measures may be discussed. The views and suggestions from the staff may be invited and recorded. If found a novel, then it may be sent to higher authorities.

### **SAFETY AWARENESS WEEK**

- Safety awareness week may be observed between 11<sup>th</sup> January to 17<sup>th</sup> January every year,
- During the above period
  1. Safety awareness programmes to staff may be arranged.
  2. New PPEs may be supplied(New / replacement)
  3. Employees may be given with Safety badges to wear.
  4. Seminars may be arranged
  5. Essay / Slogan / Other competitions may be arranged
  6. Consumer safety awareness campaigns may be conducted
  7. Pamphlets on Consumer safety may be distributed
  8. Safety awareness programmes at Schools / Colleges / Educational institutions may be arranged
  9. Mass SMS may be sent
  10. Wide propaganda at Media/ slides at theatres / Televisions / may be arranged
  11. Consumers' active participation in the awareness programme may be encouraged.

### **Safety Topics in Departmental Trainings**

- The Training Centres / Technical Institutes under the control of Human Resource Development has to include Safety related topics in all technical training programs for field staff and Engineers.
- They may also conduct exclusive training programs related to Safe working procedure effective handling of line clears, First Aid, Fire safety, Basic Disaster management etc for Engineers / Field staffs.

### **PROFILE FOR ENGINEER'S TRAINING PROGRAMME:**

- Safety-Overview
- Accidents, Causes-prevention-unsafe act-Unsafe conditions
- Case studies on accidents
- Earthing practices-role and responsibility of Section Officer in Earthing-Practical demo on Earth resistance measurement.
- LC procedures-attending breakdowns
- Consumer safety

### **PROFILE FOR Staff's TRAINING PROGRAMME:**

- Safety-Overview-impacts of accidents
- Accidents-causes-prevention-unsafe act-unsafe conditions.
- Case studies and critical observations on accidents.

- Role of Earthing on accident prevention-Earthing procedures
- Proper usage of PPEs-demo on each-mock drill on waist belt rope knots
- ABCDEs of safety
- LC procedures and attending breakdowns-prediction of faults
- Consumer safety.
- Group discussion.

(Fire safety & First Aid may be added if the duration is of 2 days)

### **CONSUMER AWARENESS**

It is the bounden duty of us to create awareness on Consumer safety. Certain vital points are to be given wide propoganda to promote Consumer safety.

- Sufficient Clearances between building & Electric Lines shall be maintained.
- Do not use Electric poles, installation & stay wires etc. for other purposes.
- When you find any snapped conductor, you must immediately inform the concerned Office besides ensure that no other person is approaching the snapped conductor.
- Do not desilt near the lines.
- Do not allow children to play near Electric Lines
- Do not touch Electric appliances with wet hands, clothes etc.
- Install Earth leakage protective device at your premises, since it is mandatory.
- Use only ISI marked appliances & materials in your premises
- Do not urinate / pour water in Electric appliances / lines
- Do not repair Electrical appliances yourself
- Do not go into the water logged areas near Electric distribution boxes/ Pillar boxes.
- Remove Electrical appliances from mains only after switching OFF the supply.
- Do not dump waste / flammable near Electrical Gadgets.
- Install Plugs and switches in an accessible level to adults and inaccessible place for Kids.
- Do not allow wall sockets kept open as it may lead to entry of other insects such as wasp.
- Electric fencing is a criminal Offence which may attract imprisonment with fine also.
- Un authorized use of Electricity / Theft of Energy is criminal Offence. Please avoid it.
- Get repaired your Electrical appliances by an authorized mechanic / Electricians.
- Do not allow your trees touches the lines. Trim it at periodical intervals.
- Do not stand under Electric line during wind & rainy times.
- Do not put wet clothes in electric poles or supports.

The pamphlets containing the above awareness tips may be issued to each consumer during effecting of Service connection and acknowledgement may be obtained. The same may be recorded in the Service Connection docket.

**ANNEXURE - I**

**FORM FOR APPLICATION OF LINE CLEAR PERMIT**

LC Application No.		Date
1	Name	
2	Designation	
3	Employee No.	
4	Mobile No.	
5	Section	
6	Equipment / Feeder / Line Section on which LC is required	
7	Mention the Exact location where the work is to be carried out	
8	Date and Time of LC required	
9	Approximate duration of LC required	
10	Nature of work	
11	How many persons to be engaged in the work	
12	Any other feeder / Line crossing that location	
13	Signature	
14	Recommendation of the Officer with Name & Designation	

**OFFICE USE**

**(To be printed on back side of the LC application)**

1	LCP No. / Date	
2	Time	
3	Random No / OTP	
4	LC issued by(Name & Designation)	
5	LCP returned / Time / Date	
6	LCP cancelled by(Name & Designation)	
7	Feeder / Equipment Normalised at Time / Date	
8	Observations after normalization if any	
9	Remarks if any	
10	Signature, Name, Designation of the Operator on duty with date	

Line clear permit shall be issued to the authorized person only, on receipt of an application in the above prescribed format.

In case of any emergency LC, where the application form may be filled in and the signature of the recommending Officer could not be obtained, then in such cases a random No. / OTP may be sent to the mobile of the Officer who is authorizing the applicant. Then the OTP has to be forwarded to the applicant. On production of Random No / OTP to the SS Operator, the LC may be obtained. The same shall be recorded on the Log book.

The application for LCP shall be recorded in the Office and kept in safe custody. The same shall be reviewed by the Officer in charge then and there before the next day.

**ANNEXURE – II**  
**LETTER TO CONSUMER TO PROVIDE ADEQUATE CLEARANCE**  
**TANGEDCO LTD**

From

The Competent authority,  
TANGEDCO

To

The applicant with address

Sir,

Sub:-Elec- inadequate clearance as per CEA regulation-request for action for making sufficient clearance

Ref:- your application dated (if applicable)

The building / premises under Door No. (Complete address) has been inspected by the undersigned on----- --. During such inspection the following unsafe condition are noticed.

- The Vertical / Horizontal clearance between the HT / LT line as per CEA safety regulations shall be\_\_\_\_\_metres.
- But the actual clearance is\_\_\_\_\_ metres (Please Quote the regulation No & statutory clearance)
- As per regulation 27(ii) and 30 of the Distribution code enacted by the TNERC under Electricity Act 2003, the consumer's installation should invariably comply with statutory provisions of the safety regulations.

Note :

i). If the application is not registered, the same shall be returned as per regulation 27(3) of Distribution code by mentioning the same in the above notice.

ii). If the application is already registered it should be cancelled for non compliance of statutory provisions as per 27(1) of the Distribution code.

Hence you are requested to comply with the safe clearance mandated by the safety regulation by making an application in the Office of the undersigned for making necessary deviation of the Lines to a safe clearance limit and you shall require to pay the amount on receipt of communication from the undersigned.

(Upon satisfactory clearances are met, then only your application for service connection will be considered) (if applicable)

Please note that If by the inadequate statutory clearance, (un safe condition) as said above, any untoward incident happens, TANGEDCO will not be responsible for such happenings and you will be solely responsible for such occurrences if any.

Sd/-date

Authorised Officer/ TANGEDCO

Copy to



**ANNEXURE – III**  
**ACCIDENT REPORTING FORMS**

**PRELIMINARY**  
**REPORTFORM A**  
**FORM FOR REPORTING ELECTRICAL ACCIDENTS**

1. Date and time of accident.
2. Place of accident (Village/Town, Tensil/Thana. District and State).
3. System and voltage of supply (Whether Extra High Voltage (EHV)/High Voltage (HV) / Low Voltage (LV) line, sub-station/generation Station/consumer's Installations/service lines/other installations).
4. Designation of the Officer-in-charge of the generating company/Licensee in whose jurisdiction the accident occurred.
5. Name of the owner/user of energy in whose premises the accident occurred.
6. Details of victim(s)

**(a) Human**

Sl.No	Name	Father's Name	Sex of Victim	Full Postal Address	Approximate Age	Fatal/ Non Fatal
1	2	3	4	5	6	7

**(b) Animal**

Sl.No	Description of Animal(s)	Number (s)	Name (s) of Owner(s)	Address (a) of owner (s)	Fatal Non-Fatal
1	2	3	4	5	6

**7. In case the victim(s) is / are employee(s) of supplier:-**

(a) designation of such person(s)

(b) brief description of the job undertaken, if any:

(c) Whether such person / persons was / were allowed to work on the job.

**8. In case the victim (s) is / are employee (s) of a licensed contractor:-**

(a) did the victim (s) possess any electric workmen's permit (s), Supervisor's certificated of competency?

If yes, give number and date of issue and the name of issuing authority:

(b) Name and designation of the person who assigned the duties of the victim(s).

9. In case of accident in the system of the generating company/licensee, was the permit to work (PTW) taken?

10. (a) Describe fully the nature and extent of injuries, e.g., fatal/disablement (Permanent or temporary) of any portion of the body or burns or other injuries.

(b) In case of fatal accident, was the postmortem performed?

11. Detailed causes leading to the accident.

(To be given in a separate sheet annexed to this form)

12. Action taken regarding first aid, medical attendance etc., immediately after the occurrence of the accident (give details).

13. Whether the District Magistrate and Police Station concerned have been informed of the accident (if so, give details).

14. Steps taken to preserve the evidence in connection with the accident to extent possible.

15. Name and designation (s) of the person (s) assisting, supervising the person (s) killed or injured.

16. What safety equipments were given to or used by the person (s) who met with this accident (e.g. rubber gloves, rubber mats, safety belts and ladders etc)

17. Whether isolating switches and other sectionalizing devices were employed to deaden the sections for working on the same? Whether working section was earthed at the site of work?

18. Whether the work on the live lines was undertaken by authorized person(s)? If so, the name and the designation of such person(s) may be given.

19. Whether artificial resuscitation treatment was given to the person (s) who met with the electric accident? If yes, how long was It continued before its abandonment?

20. Names and designations of persons present at, and witnessed, the accident.

21. Any other information /remarks

Signature

Name

Designation

Person reporting

Place:

Time:

Date:

**FORM FOR REPORTING OF ACCIDENT  
DETAILED REPORT  
INVESTIGATION REPORT - PART - A - TECHNICAL**

**I. Brief Particulars of Accident Investigated**

- 1. Date of Accident :
- 2. Place of Accident :
- 3. Classification Departmental/Non - Departmental/  
Fatal/ Non-Fatal/Electrical/Mechanical :
- 4. Name of the Injured :
- 5. Sex and Age :
- 6. Date of Investigation :
- 7. Name Designation and Address of the Party  
who reported the accident :
- 8. Residence of the causality :
- 9. Name and designation of the Investigation officer :

**II) Details of Investigation made**

- a. Name of witnesses examined Statements of  
witness recorded (copies to be enclosed) :
- b. Whether statements obtained :
  - Of the injured, if non-fatal :
  - Of the foreman /LT Supervisor :
  - Of the Manager / or employed if the injured  
met with the accident in a factor :
  - Of the Medical Officer who attended the  
injured Police Report. :

iv) Exhibits examined and sites inspected by the  
Investigating Officer :

v) A neat sketch showing the site of accident:

III) Descriptive Report of the Accident :

IV) Analysis of the accident and findings of the investigation officer :

a. Non - Departmental(Electrical)

Whether mental Unbalance or attempt Suicide :

b. Departmental(Electrical)

Whether due to Unsafe act or failure to use safety equipment LC precautions etc., Use of Safety

Appliance :

1. Whether belt rope used:
2. Whether rubber gloves / gauntlets used:
3. Whether LC availed:
4. Whether lines/equipments discharged/and earthed:

c. Departmental (Mechanical) falls generally under the following: Falls from pole, during climbing or during work.

Handling of Materials.

Note: The Investigating officer will try to find the root cause of the accident and make recommendations on the preventive measures to be taken to prevent recurrence. The responsibility for the occurrence of the accident and action taken against the erring staff.

**Investigation Report Part - B - Administrative**

**Additional particulars for compensation claims.**

**a. Non - Departmental**

- 1. Name of injured : \_\_\_\_\_
- 2. Full Address : \_\_\_\_\_
- 3. Occupation : \_\_\_\_\_
- 4. Approximate Annual Income : \_\_\_\_\_
- 5. Nature of Injury : Fatal or Non - Fatal:  
If Non - Fatal - Nature and extent of disability for  
which compensation claims is preferred : \_\_\_\_\_
- 6. Name and full address and relationship to the  
injured of the claimants : \_\_\_\_\_
- 7. If the compensation claim is in respect of any  
Property, details of property and their value : \_\_\_\_\_

**b) Departmental:**

- 1. Name of injured : \_\_\_\_\_
- 2. Designation : \_\_\_\_\_
- 3. Service roll /check No : \_\_\_\_\_
- 4. Section: \_\_\_\_\_ Sub-Division: \_\_\_\_\_ Division: \_\_\_\_\_
- 5. Whether accident occurred out of or in the course of  
employment: \_\_\_\_\_
- 6. Date from which he is in service : \_\_\_\_\_
- 7.a) Particulars of pay for one year immediately  
Proceedings the date of accident for fixing  
compensation amount : \_\_\_\_\_
- b) Whether wages were allowed for the date of  
accident : \_\_\_\_\_
- 8. Date of accident:  
If fatal date of death : \_\_\_\_\_  
If Non-fatal : \_\_\_\_\_

- Date from which he was disabled :
- Date of admission to the Hospital :
- Date of discharge from the Hospital :
- Date of fitness certificate :
- Date of rejoining duty :
- Name and Designation of Medical Officer :
9. In case of Permanent disability :
- Nature of Injury :
- Part affected :
- Percentage loss of earning capacity :
- Date of issue of medical certificate :
- Name and Designation of Medical Officer :
10. In case of fatal accident:
- Name and full address of heir/s :
11. Whether the accident was due to negligence  
of the workmen. If so action taken against the  
workmen may be briefly stated. :

Signature of Investigation Officer,

N.B. Part 'B' report may be sent separately.

**INVESTIGATION REPORT FOR FATAL ACCIDENT TO HUMAN BEINGS**

1.	Name of the circle	
2.	Name of the Division and sub division	
3.	Name of the section	
4.	Location of Accident	
5.	Date and Time of Accident	
6.	Name of Person(S)	
7.	Whether Departmental or Non-departmental person (S) if departmental person please specify the designation	
8.	Nature of Accident whether Mechanical / Electrical / Line.	
9.	If Electrical please specify voltage class of the Equipments / Line	
10.	Details such as whether the accident has occurred due to defective installation of consumer in the consumer premises	
11.	Whether the Board is responsible to pay compensation and date	
12.	Whether Police complaint was lodged and crime No. & date	
13.	Brief details of accident	
14.	Cause for the accident	
15.	Date of inspection of accident spot by the Superintending Engineer	
16.	Suggestions of the Superintending Engineer for averting similar accidents	
17.	Details of preventive / punitive action Suggested / taken to prevent recurrence	

**SUPERINTENDING ENGINEER**



**ANNEXURE – IV**  
**SAFETY / AUDIT**

**FIELD JOB AUDIT Report**

Reportt No:

Date:

Location: \_\_\_\_\_ Month/Year: \_\_\_\_\_

1. Name of Supervisor onsite \_\_\_\_\_

2. Nature of Job:

3. LCP No.: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

4. Name & Designation of

workmen 1.

2.

3.

4.

5.

5. Any unsafe conditions noticed:

Sl. No	Unsafe condition	Remarks
1	No message in job allocation	
2	No proper LCP obtained	
3	No proper Supervision at Site	
4	Not using safety equipment like helmet / hand gloves / fuse puller / safety shoes/ Belt rope	
5	Using improper tools	
6	Shortage of tools	

Sl. No	Unsafe condition	Remarks
7	No danger board on switchgear control	
8	No Safety zone is created	
9	Equipment / Line not properly /not earthed	
10	Bad site conditions	
11	Condition of PPEs	

Additional remarks if any:

Signature of Committee members

**ANNEXURE – V**  
**WARNING CHECK SLIP BEFORE ATTENDING FOC**

1	Whether the correct feeding distribution transformer is approached which is connected with the particular LT pole in which FOC is going to be attended.	
2	Whether any street light wire is crossing the LT network from other distribution transformer.	
3	Whether LT lines on either side of the DT is separated from adjacent distribution transformer, in all phases, neutral and street light wires.	
4	Whether 3 knives of the AB switch are fully opened.	
5	In case of cable connected distribution transformer, whether the feeding HT cable is isolated, discharged and earthed.	
6	In case of LT side being cable connected, whether the LT fuse in the DT pillar boxes removed.	
7	After opening the AB switch, whether all the three incoming jumpers and lightning arrester jumpers are intact without cutting or hanging.	
8	Whether AB switch handle is locked	
9	Whether supply cut off after opening AB switch, is confirmed by physically watching lights in nearby services of the LT pole in which FOC is to be attended.	
10	Whether safety appliances such as gloves, belt rope and earth rods are used properly and effectively.	
11	Whether earth rods are placed closely on either side of the LT pole in which FOC is to be attended.	
12	Whether all UPS and Generator in consumer services fed by the DT are isolated and got confirmed.	