SAFETY MANUAL

ON TRANSMISSION SYSTEM



ASSAM ELECTRICITY GRID CORPORATION LIMITED

May 12, 2014

SAFETY POLICY STATEMENT:

"The personal safety and health of each employee of this company is of prime importance. Prevention of occupationally induced injuries and illnesses is of such consequence that it will give precedence over productivity, whenever necessary. To the greatest degree possible, as a statutory and moral responsibility, management will provide necessary equipment, procedures and training required for personal safety and health. These requirements are no less than the objective of the company"

"Success of the policy lies on all employees complying with safety requirements relevant to their responsibility"

"100% Safety and 0% accidents/ mishaps"

"Safety at every stage, safety first and safety always"

Introduction

Everyone uses electricity, however; the electrical safety principles taught to us at various point of time are either forgotten or overlooked by us. As such precious lives are lost and properties are destroyed every year by electrical accidents and fires.
Management of industrial and electrical plants and consumers of electricity tend to neglect safety aspects at the risk of personnel. A casual glance at some electrical installation reveals need of essential safety measures such as fence, good earthing system, clean insulators, well dressed cables in cable trench and clean surroundings.
With ever-increasing use of electricity by domestic, industrial, commercial, agricultural/ rural and other consumers, the safety of personnel, plants and equipment is gaining due attention.
Electricity is a very safe and ***controllable*** form of energy, ***only if*** the installations, plants and equipment are built with adequate safety precautions and users are aware and follow safety rules in every action. Safety Principles, Rules and acts, Procedures have been documented by various authorities from time to time for use at Project Sites, Plant Sites and Customer Premises.
Safety Management and Safety Precautions at every stage (design of plant and equipment, manufacture of equipment and component, testing, dispatch, site construction work i.e. erection, testing and commission work, operation & maintenance (O&M)of electrical plants/equipment and casual use of electricity).

The risk includes **Electrical Shocks, Fires and explosions, Fall of objects on head, Fall of persons from height, Flashovers and faults** in equipment and machines etc. accidents and fires results in injuries, loss of life and loss of property.

The accidents occur due unsafe conditions / practice/ acts, lapse of management, unawareness of individuals, lack of training, lack of procedures and carelessness. Behind every accident there are several reasons, chances misses.

Accidents can be completely eliminated by following Safety principles and procedures. Management, Supervisors and Technicians have obligation towards safety and prevention of accidents and loss. Management should be committed to safety. **Safety should be organised and managed.**

Few lines to bear in mind:

IGNORANCE OF RULES AND REGULATION WILL RESULT IN ACCIDENT TO HIMSELF AND HIS CO-WORKERS.

NO OPERATION IS SO URGENT THAT IT HAS TO BE PERFORMED IN UNSAFE MANNER.

TIME IS IMPORTANT BUT SAFETY IS MORE IMPORTANT.

SAFETY FIRST, NEXT AND ALWAYS.

QUALITY GETS THE BUSINESS, SAFETY GETS QUALITY.

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CHAPTER – 1

STATUTORY REQUIREMENTS PERTAINING TO SAFETY

Assam Electricity Grid Corporation Ltd. (AEGCL) recognizes and accepts its commitments for establishing and maintaining Safe and Healthy work environment for all its employees in every sphere of its activities. We dedicate ourselves to improve our safety performance, well-being of employees on continual improvement basis.

For observance of the above, provisions of various Acts, Rules, standards are to be abided. The relevant Acts, rules, standards are described below.

A. Electricity Act 2003

1) Section 53: Provisions with respect to Supply generally

Provision relating to safety of electricity supply- the authority may, in consultation with the state Government specify suitable measures for-

a) Protecting the public (including the persons engaged in, transmission or distribution or trading) from dangers arising from the generation, transmission or distribution or trading or electricity, or use of electricity supplied, or installation, maintenance or use of any electric line or electrical plant.
b) Eliminating or reducing the risks of personal injury to any person, or damage to property of any person or interference with use of such property.
c) Prohibiting the supply or transmission of electricity except by means of a system which conforms to the specifications as may be specified.
d) Giving notice in the specified form to the Appropriate Commission and the Electrical Inspector, of accidents and failures of supplies or transmissions of electricity.
e) Keeping by generating company or licensee the maps, plants and sections relating to supply or transmission of electricity.
f) Inspection of maps, plants and sections by any person on payment of specified fee.
g) Specifying action to be taken in relation to any electric line or electrical plant, or any electrical appliance under the control of a consumer for the purpose of eliminating or reducing the risks of personal injury or damage to property or interference with its use.

As per the provision contained in Electricity Act 2008 their shall be a body to be called CEA to exercise such functions & perform such duties as are assigned to it under this act.
The CEA established under section III of electricity supply act 1948 (54 of 1948).
The section 73 of EA 2003 says that the CEA shall perform such function and duties as central Govt may prescribe or direct and in particular to

2) Section 73 of Electricity Act

Functions and duties of Authority:

a) Advice the Central Government on the matters relating to the national electricity policy, formulate short-term and perspective plants for development of the electricity system and co-ordinate the activities of the planning agencies for the optimal utilization of resources to sub-serve the interests of the national economy and to provide reliable and affordable electricity for all consumers.
b) Specify the technical standards for construction of electrical plants electric lines and connectivity to the grid.
c) Specify the safety requirements for construction, operation and maintenance of electrical plants and electric lines.

d) Specify the Grid Standards for operation and maintenance of transmission lines.
e) Specify the conditions for installation of maters for transmission and supply of electricity.

B. The Electricity Rules 2005 (Formerly known as IE Rules 1956)

Further to the provision of EA 2003, the electricity Rules 2005 formerly known as Indian electricity Rules 1956 in the rules 29 through 46 under chapter IV" general safety requirement" lay down the safety requirements for strict observance Rules 63 through 71 under chapter VII together with rules 74 through 93 further describes provision to be observed for safety.

C. Provision of the Indian Standards

Provision of Indian Standards vide its specification No.IS:5216 (Part I) 1982 (Reaffirmed 1995) "Recommendations on safety procedures and practices in electrical works - General" and IS:5216 (Part II) 1982 (Re Reaffirmed 1995) "Recommendation on safety procedures and practices in electrical work – life saving Techniques detail out the safety instruction safety instruction and precaution which every employee who may be concerned with the installation, operation and maintenance of electric lines and apparatus to be conversant with.

It further expects that supply undertakings have normally to prepare a written document which should be strictly performed by the employees of undertaking while under taking the construction operation and maintenance of electric lines and apparatus.

D. Central Electricity Authority Notification

In exercise of the power conferred by clause (c) of section 73 read with subsection (2) of section 177 of the Electricity Act 2003, the Central Electricity Authority New Delhi, made the regulations called "Central electricity Authority regulations, 2008. (Safety requirements for construction, operation and maintenance of electrical plants and electric lines)
As per clause 3.0 of the said regulation, the regulation so formulated shall apply to all the electrical plants & electric lines already commissioned as well as those under construction.
Important and note worthy clause of the notification are as under:

cl. no.6	Provision relating to the owner
cl. no.7	Preparation of safety Manual
cl. no.8	Safety organization i.e. appointment of safety officer and construction of Safety committee
cl. no.9	Provisions relating to the contractors
cl. no.10	reporting of Accidents
cl. no.11	Emergency Management Plan
cl. no.12	Medical facilities
cl. no.13	Safety Training & awareness
cl. no.14	Power to remove difficulties

Schedule I - Minimum contents of safety manual for construction of electric plants & Electric lines
Schedule II - Minimum contents of safety manual for operation and maintenance of electric Plants & electric lines
(Note: In Sch. I &II, generation plant is not applicable for transmission side)

CHAPTER – 2

TERMINOLOGY DEFINATION

1. **Authorized Person**:- "*Authorized person*" means a person authorized.

2. **Dead:-** "Dead" means at or about earth potential and disconnected from any live system: PROVIDED that an apparatus separated from a live conductor by a spark gap shall not be deemed to be "dead".

3. **Earthed:-** "Earthed" or "connected with earth" means connected with the general mass of earth in such a manner as to ensure at all times an immediate discharge of energy without danger;

4. **Ground (noun)**:- "Ground" the connection, established either intentionally or accidentally of an electric circuit or equipment with reference ground through a conductor, or other conducting object or substance.

   Ground (reference):- That conductive body, usually earth, to which an electric potential is in reference.
   Ground (Verb):- Connecting or establishing a connection, either intentionally or accidentally, of an electric circuit or equipment to reference ground. Connect to earth or some conducting body that serves in place of earth.

5. **Guarded:-** "G*uarded*" Protected by personnel, or covered, fenced, or enclosed by means of suitable casings, barrier rails, screens, mats, platforms, or other suitable devices in accordance with standard barricading technique designed to prevent dangerous approach or contact by persons or objects. (Wires that are insulated but not otherwise protected are not considered guarded.)

6. **Ground System**:- "G*rounded System*" A system of conductors in which at least one conductor or point (usually the middle wire or neutral point of transformer or generator winding) is intentionally grounded, either solidly or through a current-limiting device (not a current-interrupting device).

7. **Permit issue officer**:- "P*ermit issue officer*" is a person who is authorized for ensuring that a controlling switches and circuits have been isolated, made dead and inoperative and that adjacent circuits have been made safe for the work to be carried out and who is authorized to issue the 'Permit to work'.

8. **Permit to work (PTW)**:- "*Permit to work*" means a form of declaration signed by and given by one authorized person to another authorized person in charge of work to be carried out on or adjacent to any electrical apparatus, mains or service lines, for the purpose of making known such latter person exactly what apparatus, mains or service lines are made dead and earthed and safe for working.

9. **Sanction for Test (SFT)**: A **Safety Document** specifying the EHV / HV equipment, on which the testing to be carried out on which requires the removal of **Primary Earths or Testing of Electrical system** and the action taken to achieve Safety from the system.

10. **Protective Devices**:- "*Protective device*" means devices such as rubber gloves, rubber gauntlets, line hose, rubber boots, or other insulating devices, which are especially designed for the protection of workmen.

11. **Low voltage**:- "*Low*" where the voltage does not exceed 250 volt under normal condition subject, however, to the percentage variation allowed by these rules;

12. **Medium Voltage**:- "*Medium*" where the voltage does not exceed 650 volts under normal conditions subject, however, to the percentage variation allowed by these rules;

13. **High Voltage**:- "High" where the voltage does not exceed 33,000 volts under normal conditions subject, however to the percentage variation allowed by these rules;

14. **Extra High Voltage**:- "Extra high" where the voltage does not exceeds 650 volts under normal conditions subject, however, to the percentage variation allowed by these rules;

15. **Circuit:-** "Circuit" means an arrangement of conductor or conductors for the purpose of conveying energy and forming a system or branch of a system;

16. **Circuit Breaker**:- "Circuit breaker" means a device, capable of making and breaking the circuit under all conditions, and unless otherwise specified, so designed as to break the current automatically under abnormal conditions;

17. **Conductor:-** "Conductor" means any wire, cable, bar, tube rail or plate used for conducting energy and so arranged as to be electrically connected to a system;

18. **Cut out**:- "Cut-out" means any appliance for automatically interrupting the transmission of energy though any conductor when the current rises above a predetermined amount, and shall also include fusible cut-out;

19. **Danger**:- "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, attendant upon the generation, transmission, transformation, conversion, distribution, or use of energy;

20. **Inspector**:- "Inspector" means an Electrical Inspector appointed under s.36;

21. **Installation:-** "Installation" means any composite electrical unit used for the purpose of generating, transforming, transmitting, converting, distributing or utilising energy;

22. **Neutral conductor**:- "Neutral conductor" means that conductor of a multi wire system, the voltage of which is normally intermediate between the voltage of the other conductors of the system and shall also include return wire of the single phase system;

23. **Non–licensee:-** "*Non-licensee*" means a person generating, supplying, transmitting or using energy to whom any of the provisions of Part III of the Act apply;

24. **Owner:-** "*Owner*", "agent", and "manager" of a mine have the same meaning as are assigned to them in the Mines Act, 1952 (35 of 1952);

25. **Supply:-** "*Supply*", in relation to electricity, means the sale of electricity to a licensee or consumers;

26. **Switch:-** "*Switch*" means a manually operated device for opening and closing or for changing the connection of a circuit;

27. **Switch gear:-** "*Switch gear*" shall denote switches, circuit breakers, cut-outs and other apparatus used for the operation, regulation and control of circuits;

28. **System:-** "*System*" means an electrical system in which all the conductors and apparatus are electrically connected to a common source of electric supply;

29. **Area of supply:-** "*Area of supply*" means the area within which a distribution license is authorized by his license to supply electricity;

30. **Company:-**"*Company*" means a company formed and registered under the Companies Act, 1956 and includes anybody corporate under a Central, State or Provincial Act;

31. **Electrical Inspector:-** "*Electrical Inspector*" means a person appointed as such by the Appropriate Government under sub-section (1) of section 157 and also includes Chief Electrical Inspector;

CHAPTER – 3

SAFETY AT WORK PLACE

Conditions and educating the employee on safe working practices & procedures in substation and on transmissions, both construction as well as the O&M, one critical Safety at work place primarily focuses on the protection and maintenance of employee's physical wellbeing that may be adversely affected by unsafe working conditions. It also focuses on safeguarding the workplace from potential hazards of fire and other accidents that may result in damage to the company and people. Identifying and eliminating of potential unsafe functions of safety team, workplace safety also intends to cover environment protection by reducing discharge, minimize, emission and ensuring adverse impact on social life of the local community.

With the continuous pressure for cost reduction (downtime of the equipment), quantity enhancement (addition of new assets) and lead time redemption, safety takes a backseat by way of making several undesirable compromises, Though safety systems are in place, their implementation and adherence to them, is found lacking.

Emergency preparedness is generally judged by conducting mock drill but gaps are observed with respect to employee's awareness of evaluation processes and action to be initiated during an emergency. Though safety equipment is made available, knowledge about their usage and maintenance over a period of time have been seen lacking in many employees. Safety's standards (with respect to fire safety, hazardous material handling and safety practices/procedure in construction and O&M of substation and transmission lines) are although are well, defined are generally not followed and successful implementation fails, resulting into untoward incidents and accidents.

There are several factors leading to low safety practices in the organization and challenges in making the workplace safer, and these factor differ across the implementing authority. However the reasons and challenges can be divided into the following broad categories.

- **Understanding of and adherence to safety standards**
- **Safety training and its effectiveness**
- **Cultural issues**

Use of personnel protective equipment (**PPE**) has been a major concern for most of us. Although necessary PPE are provided, there is lack of awareness (negligence and ignorance) about impact of not using them. Another key point to be noted is that the adherences to safety standards are different among different group of employees (contract labour, workmen and staff) in the organization.

Despite training being one of the most critical aspects to ensure safety, this has not been given much importance to. It is therefore necessary to set as a policy that without safety training and awareness, no employee should be allowed to work.

No of several strategies are followed by many companies for adopting highest level of safety standards. One of them is reward to the employees for following the highest level of safety standards and penalties to those who do not follow basic safety rules.

As a cultural issue and its impact on safety, it is necessary to ensure that all the employees are trained before starting working in their area and provided with PPE. A system to penalize for violating the safety practices may invite trouble but it is a need of the hour to cultivate the idea in the minds of the workers/employees/staff. At the same time, top management in line needs to lead by setting an example of adhering to safety practices/procedures as high as possible. The concept of behavioural safety is being implemented by some top ranking companies to reduce the no of accidents and loss of production time. Such

a concept, together with reward and recognition for safety adherence, shall help defiantly in decrease of the accidents.

If an employee adheres to safety practices, he needs to be recognized similarly if an employee points out unsafe working conditions, it needs to be accepted & he should be recognized. It may be difficult to digest, but needs to do so.

Unfortunately, gap in terms of learning from the accident has always been a low and result in recurrence of the similar accidents. The data collected & compiled can provide root cause after analysis of the accidents.

Realizing the need for and the benefit of safer working place and the role it plays in improving employee's morale is gaining high importance all over the world. Accidents and their financial impact to both the company and the employee is to be seriously analysed & be given wide publicity as an effort towards awareness of personal safety and safe working place.

One of the proactive approaches is a regular safety audit process. Its deployment is necessary to identify and eliminate unsafe working conditions and all in the construction and O&M wings of substation and transmission lines.

As said in the safety policy statement, ***100% safety and 0% accident/mishaps "And" safety at every stage, safety first and safety always"***, shall lead to the success of the company.

CHAPTER – 4

Responsibility Assignment

Success in implementation of safety policy in the company lies in assigning clear responsibility for safety and health. Clear assignment of responsibility as described here in after will allow each employee to know what activities and behaviours are expected of him, rather than assumption or miss interpretation of what he needs to do. Unless it is explicitly understood, it will not be possible to establish accountability for the implementation of the safety policy. Having assessed the various activities in the company, task to be accomplished by each department is described below.

4.1. Corporate Office Will:

- ✓ Promote a safe and healthy culture throughout the company
- ✓ Set a high standard for safety and health practices & lead them by example.
- ✓ Ensure that the needed financial, material and personnel resources are provided to achieve the goals and objectives of safety and health programme.
- ✓ Ensure that the programme is fully implemented and effective.
- ✓ Upgrade the stipulated norms time to time and take corrective actions that are needed.
- ✓ Ensure that each employee is provided with adequate and appropriate occupational safety and health training.
- ✓ Review each accident and conduct any investigation where in an accident has resulted in serious injury (fatal – nonfatal) or property damage.
- ✓ Review the programme on an annual basis.
- ✓ Ensure the companies compliance with all applicable federal & local safety and health requirements.
- ✓ Ensure that the safety and health policies are comprehensive & effective.
- ✓ Promote safety & health and serve as a resource to all staff.

4.2. Zonal Office Will:

- ✓ Ensure that each element of programme is implemented within the periphery of the zone.
- ✓ Ensure that all circles and down below up to foreman/supervisor in the jurisdiction comply with the programme.
- ✓ Ensure that all required documents (including the OSHA injury and illness log whenever adopted) are maintained.

4.3. Circle Office Will:

- ✓ Ensure that safety/health surveys are conducted in his/her circle on regular basis, frequently. Once per quarter.
- ✓ Ensure that each equipment in the jurisdiction of circle is properly maintained.
- ✓ Ensure that each Division, S/D substation (substation & line maintenance) up to supervisor, (JM) and employees comply with the programme.
- ✓ Ensure that **PPE** (Personal protective equipment) are made available to respective employees.

4.4. Divisional Office Will:

- ✓ Ensure that each employee in his/her division receives appropriate training upon initial assignment, and later on the changes in the process, procedures, equipment or assignment.

- ✓ Ensure that each Engineer (Asst. Manager / Jr. Manager) and employee in his/her division complies with the programme.

4.5. Substation Level Will:

- ✓ Ensure that each employee receives refresher training whenever required by law, changed procedures or whenever circumstances indicate the need for training.
- ✓ Conduct a daily safety and health inspection of his/her work area.

4.6. Each Employee:

- ✓ Be an active participant in the safety and health programme
- ✓ Perform all the tasks in accordance with established policies, procedures and safe work practices.
- ✓ Question any unsafe and unhealthy practice, procedure or condition and act to correct and report it
- ✓ Inspect all the tools/equipment, prior to use, to identify any hazard. Also preserve those in a prescribed manner so that they can be the best friends at your workplace.
- ✓ Report any injury/injuries, illness or accident to the appropriate authority.

4.7. Safety Committee Will:

Having understood the gravity of the situation, to ensure effective implementation of the steps taken to reduce the accidents and also to have close monitoring of the accidents and avoid recurrence of the same the Safety Committee are formed.

- Safety Committee shall meet once in a month to review the adoption of safety practice at all field work levels.
- Safety committee shall ensure availability of all safety equipment/tools with the linemen and Section Officers.
- Safety Committee shall ensure availability of Safety Manuals in all the sections.
- Safety committee shall ensure strict adherence of implementing "Work Permit" practices in the field. The respective AGM shall get the Work Permit (**PTW**) & Sanction for Test (**SFT**) formats printed and supplied to the field with instructions to adopt within two weeks.
- The Safety Committees shall ensure imparting Safety Training to all the employees.
- The Safety Committee shall also review whether periodical testing of safety equipment is done or not and ensure proper working condition of the safety equipment.
- Safety Committees shall review the identification of hazardous and dangerous installations, Division wise, and the necessary recommendation for rectification to be carried out.
- Will ensure that Safety Audit is carried out annually against each Substation. Safety Committee will appoint Safety Auditor.

4.8. Safety Audit

The format for safety inspection & safety audit on maintenance of Substation & Transmission line is as follows:

Safety Inspection Report by Resident Engineer in Substation or bay extension works and associated Tr. Line under O & M

Date of Safety Inspection :_____

Description of Work:_____

Sl No	Item Description	Remarks
1	All Supervisors/Staff/workers and contractor workers are using PPE at site or not.	
2	Healthiness of T & P being used at site (Visual Inspection)	
3	Area demarcated from charged / uncharged area with caution tape	
4	Effective earthing in S/S. Availability of Grounding equipments and their healthiness (visual inspection) i.e. Discharge rod, sufficient number of earths etc.	
5	Enforcement of safety documents i.e. PTW / SFT. Even for small job are being ensured by supervisor or not. Whether PTW / SFT is been filled properly	
6	Whether all safety norms / procedures relevant to nature of work are being adopted or not by staff/contractors	
7	Describe any potential hazard observed i.e broken cable trench cover, stacking of materials of contractor works.	
8	Position of fire extinguishers, fire protection system etc in S/S.	
9	House keeping (General cleanliness) in S/s, vegetation/grass in S/s.	
10	First Aid box in S/S is adequate & maintained or not	
11	Action for non compliance	
12	Any other	

Name, Designation & Signature

Copy to:

GM of Zone / DGM of Circle.

Safety Inspection Report by GM in Substation or bay extension works and associated Tr. Line under O & M

Date of Safety Inspection :_____

Description of Work:_____

Sl No	Item Description	Remarks
1	All Supervisors/Staff/workers and contractor workers are using PPE at site or not.	
2	Area demarcated from charged / uncharged area with caution tape	
3	Availability of Grounding equipments and their healthiness (visual inspection) i.e. Discharge rod, sufficient number of earths etc.	
4	Describe any potential hazard observed i.e broken cable trench cover, stacking of materials of contractor works.	
5	Fire Fighting system (healthiness)	
6	House keeping (General cleanliness) in S/s, vegetation/grass in S/s. Stacking of materials in open and store	
7	First Aid box in S/S is adequate & maintained or not	
8	Penalty imposed / Action for non compliance	
9	Display of safety promotional / propagating items in Substation	
10	Any other	

Signature
GM, (LAZ/UAZ)

SAFETY AUDIT FOR SUBSTATION

Name of the Substation: Date:

Sl No.	Activity	Remarks
1. (a)	**Display of SLD of S/S. in Control Room**	:
(b)	**Identification of Bay Equipment & Phase Indication at Substation**	:
(i)	Bay indication	:
(ii)	Equipment identification & numbering	:
(iii)	Phase Indications R, Y and B	:
(iv)	MOM box for Earth Switches painted Green	:
(c)	**Safety awareness (measures taken for improvement of Safety)**	:
(i)	Display of Safety slogans at prominent locations	:
(ii)	Display of Caution Boards	:
(iii)	Display of prohibited area	:
(iv)	Display of Danger Boards (LT/HT/EHT)	:
(d)	**No. of Safety related Training Programs / workshops organized in the S/S. in a year**	:
2. a)	**Availability of First Aid Box with full recommended contents**	:
b)	**Availability of balloon type respirator** (IS: 1910 – 1961)	:
c)	**No. of persons trained in First Aid**	:
d)	**Display of First Aid Charts at proper places**	:
3.	**Name of Safety Incharge**	:
4.	**Safety Inspections / Audits**	:
a)	**Nos and date of Safety Inspections conducted by RE (AGM)**	:
b)	**Date of Safety Audit conducted by RE (AGM)**	:
5.	**Availability of Emergency Siren in Control Room**	:

a) Status of its healthiness :

6. a) No. of mock drill conducted during year and availability of record :

b) Display of Emergency contact numbers :

7. Availability of PPE (Personal Protective Equipment) :

Descriptions	Available Qty	Status of Healthiness	Remarks
Industrial Safety Helmet (IS: 2925 – 1975)			
Zero Power Plain Glasses (IS: 2553 – 1997)			
Welder Equip. for Eye & Face protections (IS: 1179 – 1967)			
Rubberized Apron (IS: 4501 – 1967)			
Electric Shock Resistant Hand Gloves (IS: 4770 – 1968)			
Face Shield for working in Batteries (IS:8521 – 1977)			
Acid Resistant			
Hand Gloves for Battery Room			
Leather Hand Gloves			
For Welders/Cutters/Grinders (IS:6994 – 1973-Part-I)			
Cotton Hand Gloves for material handling			
Gum Boots			
Any Other:			

8. Earthing

a) Check the earth mat resistance :

b) Availability of discharge rods :

c) Equipment Earthing (visual inspection) :

Check proper connection & rusting etc. at Tr / Reactor / CVT / LA etc :

d) Check for flexible Door Earthing of all equipment's MB's :

e) Condition of earth pit (Visual inspection) :

Equipment wise Earth pits

9. **Fire Fighting Equipment**

(i) **Fire extinguishing location diagram** :

(ii) **Check record of periodic maintenance** :

(iii) **Detail of Fire Extinguishers** :

Location	Type & Capacity	Qty	Condition	Due Date for refill	Actual Date of refill
a) Control Room b) Maint. Room c) MCC Room d) Kiosk Room e) DG set Room f) Battery Room g) Store Room h) Any other place					

iii) **Smoke Detection System** :
Annunciation in Control Room

iv) **Hydrant System** :
(Check operation of hydrant system)

a) Condition of Hydrant female coupling (lugs are provided or not & condition of washer) :

b) Qty and Condition of hose pipes (Nos. of defective & healthy) :

c) Condition of hose pipe boxes and availability of hose pipes in the boxes :

d) Location plan of Fire hydrant system :

10. **Permit To Work / Sanction for Test and Authorization** :

i) Whether PTW format being used & issued by Authorised Person :

ii) Whether Safety Norms are being followed and ensured while issuing Permit execution of work :

iii) SFT (Sanction for Test) is followed or not :

a) Issue of PTW/SFT with details of full Isolation and earthing etc (if required)

b) Whether operating personnel are following the above as at iii(a) :

11. i. **Whether safety measures have been adopted by contractors** :

ii. **Fencing between charged and construction area or separation from charged area** :

12. Ventilation

i) Air conditioner in VRLA battery bank :

ii) Exhaust Fan for Lead Acid battery bank :

iii) Exhaust Fan for ACDB & DCDB Room :

iv) Exhaust Fan for Stores :

13. House Keeping of work places:

i) Control Room :

ii) Battery Room :

(Wash basin provided or not)

iii) LT S/S area :

iv) DG Set Building :
(Any leakage of oils and preventive action taken)

v) A/C Operation :

vi) Out door switchyard

a) Drainage facility :

1. De-Silting :

2. De-watering Pump operation :

b) Grass cutting & Weed control activities :

1. Stores :

2. Out door area weed cutting :

c) Indoor

1. Proper storage of Eqpt. / items including Free access to them :

2. Other office Buildings :

3. Township :

14. Availability of Emergency fire exit :

15. Availability of suitable ladder/platform for climbing :

/ working on LA, CT, CVT, CB, ISOLATOR etc.

16. Emergency Action Plan available and displayed in S/S

a) In case of fire :

b) Accident / Flood :

17. Illumination

a) Switchyard Area :

b) For substation Control Room :
Whether emergency lights kept in Control Room / DC supply provided for (Control room / Battery room / LT operational area / DG set room, Office complex etc)

18. Availability of T & P at S/S store and line stores

i. Frequency of checking the healthiness of T & P at Substation store and line store as per Annexure-A attached :

ii. Whether all the lifting tools and tackles have been tested for safe working load by a competent person as per relevant statutory requirement :

iii. Whether all the T & P are properly stored / placed in the store or not. :

iv. Unhealthy T & P is segregated and stored separately Action taken for its disposal :

19. Material Handling

i. Facilities available for loading / unloading / shifting of material in S/S / Line office :

ii. Healthiness of Mobile / EOT crane :

20. **Accidents**

a) Number of Fatal / Non Fatal accidents during last year :

b) Total number of Fatal / Non Fatal accidents during current year (upto_____) :

c) Implementation of recommendations of the Accident Enquiry Committee reports. (Being followed or not for corrective & preventive action) :

21. **Penalty**

Whether any penalty imposed for non Compliance Of Safety norms by contractor employee / Departmental Employee during last year. :

22. Any new concept / procedure being adopted for safety. :

23. **General Check Points**

a) Marshalling box

b) Conditions of Gaskets

c) Condition of lighting arrangement :

d) Painting & Cleaning :

24. **Others**

ANNEXURE - I

Common List for T & P articles for S/S and Transmission Line S/D.

S.No	Description	Available Qty	Present Condition	Remarks
1	**Polypropylene Rope**			
	i. 18 mm			
	ii. 25 mm			
	iii. Any other dia			
2.	**Wire Ropes Sling (Steel)**			
	i. 16 mm dia (_____Meters length)			
	ii. 20 mm dia (_____Meters length)			
	iii. 25 mm dia (_____Meters length)			
	iv. Any other dia.			
3.	**Steel Wire Rope**			
	i. 16 mm dia			
	ii. 20 mm dia			
	iii. 25 mm dia			
	iv. Any other dia.			
4.	**D-Shackle**			
	i. 20T capacity			
	ii 5T capacity			
	iii. 2T capacity			
	iv. 1T capacity			
	v. Any other capacity.			
5	**Trifor**			
	a. 5T Capacity			
	b. 10T capacity			
	c. Any other capacity			

6. **Chain Pulley Block**

   a. 5T capacity

   b. 8T capacity

   c. 10T capacity

   d, Any other capacity

7. **Ratchet Hoist**

   i) 3T capacity

   ii) Any other capacity

8 **Four Sheave Pulley** (Capacity)

9. **Two Sheave Pulley** (Capacity)

10. **Single Sheave Pulley** (Open type) capacity

11 **Single Sheave Pulley** (Close type) capacity

12. **Turn Buckle Open type**, Capacity

13. **Turn Buckle Close type**, Capacity

14. **Turn Table with brake arrangement**, Capacity

15. **Drum Lifting Hydraulic Arrangement**, Capacity

16. **Hydraulic Crimping Machine**, Capacity

17. **Hydraulic Jack, Capacity Ton**

18. **Sagging winch machine** (10T capacity with handle & support double speed)

19. **Single way rope pulley (5T)**

20. **Two Way Rope Pulley (5T)**

21. **Three Way Rope Pulley (5T)**

22. **Come along clamp**.
(Panther/Zebra/Moose)

23. **Healthiness of Ladder**.

   a) Wooden/Steel/Rope

   b) Any other material ladder

24. **Any Other:**

Note:

Those items which are subject to load bearing are to be tested for safe working load from the competent authority as per relevant statutory requirement, other items which are not load bearing are to tested as per visual inspection or as per manufacturer recommendations.

For periodicity of testing of Lifting Appliances, Lifting tools and tackle for safe working load: Rule 56 and Rule 70 of Building and other construction worker's Central Rule 1998 may be referred which is as under

Rule 56: Testing and periodical examination of lifting appliances:

a) all lifting appliances including all parts and gears thereof, whether fixed or moveable, are tested and examined by a competent person before being taken into use for the first time or after it has undergone any alterations or repairs liable to affect its strength or stability or after erection on a construction site and also **once at least in every five years**, in the manner specified in Schedule – I annexed to this Rules;

b) all lifting appliances are thoroughly examined by a competent person **once at least in every twelve months** and where the competent person making such examination forms the opinion that the lifting appliance cannot continue function safely. He shall forthwith give notice in writing of his opinion to the owner of the lifting appliance;

Explanation – For the purpose of this rule, through examination means a visual examination, supplemented, if necessary, by other means such as hammer test, carried out as carefully as the conditions permit, in order to arrive at a reliable conclusions as to the safety of the parts examined; and if necessary, for such examination, parts of the lifting appliance and gear, shall be dismantled.

Rule 70: Test and periodical examination of lifting gears - The employer shall ensure at a construction site of a building or other construction work that –

a) a lifting gear is initially tested for the manufacturer by a competent person, in a manner specified in Schedule – I to these rules before taking in to use or after undergoing any substantive alterations which renders its any part liable to affect its safety and such gears alters such test shall subsequently by retested for the use of its owner at least **once in every five years**.

b) a lifting gear in use is thoroughly examined once at least in **every twelve months** by a competent person;

c) a chain in use is thoroughly examined once at least every month by a responsible person for its use;

d) certificates of initial and periodical tests and examinations of loose gears under these rules are obtained in Form VII to these rules.

CHAPTER – 5

Hazard Identification, Analysis & Control

Having understood need of work place safety, it must be clear in mind as to in what way it is intended to identify, analyse and control new, existing or potential hazards at the work place. This must include regular inspection of facilities, review and analysis of high hazards and operations, conducting accident investigation, analyse injury trends and taking action to eliminate future injuries, together with who will be completing each activity, when to complete and how this will be evaluated for effectiveness.

It is extremely necessary that AEGCL, as an employer furnishing an employment and a place of employment which is free from recognized hazards that are or may likely to cause death or serious physical harm to our employees. This is a big challenge, for which a plan is necessary, which is a valuable tool to prevent accidents and injuries.

Identification:

Before correcting any hazard, it must be identified by preparing a list causes

1) Principal operations and locations
2) Major locations
3) Plant and office layouts

Regular inspection by identified personnel as described earlier can provide solutions.

The following will also help as tools to identify work place hazards.

1) Employee's observation
2) Employee's Monitoring
3) Job Safety Analysis
4) Accident / Injury Investigation

Danger or hazard can exist in any of the following four components of the operations

1) Material
2) Equipment
3) People
4) Environment

So be sure to evaluate all of these as we search for those hazards.

Analysis:

Once Hazards and potential hazards have been identified, we need to list the methods intended to use for analysis. Analysing hazards is an important step in reducing the potential for accidents as it will help to use the resources provided more effectively while correcting those methods as described below for easy understanding:

a) Determine the severity and probability of each hazard as follows. This will assist to prioritize the corrective action.
   - i). **Severity:** It means that type of damage or injury that would result if accident occurs.
     - High: Death, permanent disability or chronic irreversible illness.
     - Medium: Injuries (or temporary), reversible illness resulting in Hospitalization (or temporary) disability.
     - Low: Injuries (or temporary), reversible illness requiring minor supportive treatment.
   - ii). **Probability:** It means what is the likelihood that the accident will occur?
     - Greater
     - Lesser

Each of these components, when evaluated independently, can be combined together to determine "Gravity" of each hazard.
For Example: A hazard with high severity and a greater probability would have higher gravity than one with a low severity and lesser probability.
This can tabulated for sake of understanding.

Severity	Probability	Gravity
High	Greater	Greater
High	Lesser	Moderate
Medium	Greater	Moderate
Medium	Lesser	Moderate
Low	Greater	Moderate
Low	Lesser	Low

This is not a rigid method, and can be made better with experience.
Following information or course of information may be found useful in analysing the hazard.

- Loss Reports
- OSHA Injury & illness logs
- Accident Reports
- Incident or "Near Miss" Report
- Employee Input
- Your own (supervisor's) observation
- Job safety analysis
- Inspection Reports

These sources of information can assist in building accident trend analysis. If there are accident trends are acceptable, the same can indicate accident investigation and corrective action control needs to be implemented. This may also include evaluating procedures and supervision. Accident trends & alert to take a second look and re-evaluates to determine proper control for hazards.

Control:

After hazards have been analysed, it must be given the priority based on its overall gravity. Hazards can then be controlled as:

Elimination of any hazard identified
All other hazards will be controlled by using engineering or administrative controls or combination of these as appropriate
The AM/JM to correct hazards within their control & ensure that remedial measures for other hazards are planned and informed to management in ladder.
Management will evaluate the remedial measures and implement them at all other places

Administrative and work practice control for hazards be either designated as a separate programme or be a part of the procedures adopted

PPE will be used as a last option or as an interim measure

AM/JM shall monitor the progress of all abatement ( ) procedures and ensure that all affected employees are apprised of the status.

AM/JM shall co-ordinate safety communication to all vendors, sub contractors, employees working in the plant.

AM/JM shall provide feedback to the management the status of implemented control, controls pending action bottlenecks if any in implementation & needed controls based on injuries, hazards and related regulation.

Accident Investigation and Corrective Action

No one wants accidents to occur. However, ***once it occurs it must be learnt why so, so that recurrence can be prevented. Aim is to find out root cause of the accident and implement corrective action so that accident will not happen again.***

Accident Reporting:

The first step is to ensure to have an efficient and clear accident, reporting procedure and a method of collecting relevant information to find out root cause.

It is mandatory by the law to report the accident that has occurred. As per the provisions contained in **Rule 44** a of I.E. Rules 1956, (now called as "The electricity Rules 2005), a report is to be sent to the Inspector by telegraph within 24 hrs of knowledge of occurrence of fatal accident and written report, in the form set out in **Annexure XIII**, within 48 hrs of the knowledge of occurrence of the fatal and all other accidents. Where-ever possible and practicable, a telephone message should be given to the inspector immediately after the accident comes to the knowledge of authorized officer of the utilities, licensee, supplier or the contractor.

To investigate the accident properly, following guidelines may be used.

1) Who was injured?
2) Where and when did injury occur?
3) What was the injury?
4) Which part of the body was affected by the injury?
5) What object, substance, exposure or bodily motion infected or contributed to the injury?
6) How did injured person come in contact with source?
7) Which hazardous condition or circumstances caused or permitted the occurrence?
8) Where was the hazard?
9) What unsafe act, if any, caused or permitted the occurrence of the event?

Generally, direct, indirect and root causes are found for any accident. The direct cause is actual event or sometimes termed as **"unplanned release of energy or hazardous material".** The indirect causes may be unsafe act, unsafe condition or combination of the two that can tie back to back of awareness regarding safety, training imparted / availed but failed to use the knowledge acquired

Supervision or any other action: The root cause is usually related to poor implementation of management policies/procedures/accidents or it could be from personal or environmental factors.

Corrective Action:

After an accident has occurred, it is the responsibility to see that it does not recur. For this, a procedure needs to be developed to promptly correct the deficiency and act on the recommendations resulting as an outcome of the investigation. The accident investigation report should not only include suggestive action but also what action was taken & when.

A tracking system needs to be in place or devised to make certain corrective actions are taken in a timely manner. Also, the corrective actions should be examined, verified after a time, to ensure its effectiveness and improvisation.

ACCIDENT INVESTIGATION SHOULD NOT BE AN ATTEMPT TO ASSIGN BLAME BUT THE GOAL IS FACT FINDING & NOT FAULT FINDING

CHAPTER – 6

FUNDAMENTALS OF SAFETY

1. Safety is the proper planning of work, proper usage of safety tools, following safety procedures and exercise of good judgment and intelligent supervision Experience proves that majority of the accidents are preventable.

   Prevention of accidents requires the whole hearted co-operation of all employees of the organization. Capable, mentally alert employees will avoid accidents.
   An unsafe man is a liability to the organization. He is a danger to himself, his fellow workers, the public and the company.
   Accidents Do Not "Just Happen"; Accidents are the result of unsafe conditions or unsafe acts or a combination of both. ***Operating without authority***.

2. **Unsafe Acts:**

   Accident occur due to
   - Non adherence of the safety rules.

   - Non usage of proper safety gadgets for the specific work.

i. Following are the **unsafe acts** done by working person which may lead to an accident:-

   i). Working without authority and operating the switches without knowledge.

   ii). Working unsafely such as throwing materials or tools, at another worker, jumping from vehicles and platforms or unnecessary haste.

   iii). Making safety devices inoperative.

   iv). Using unsafe equipment, wrong tools for the job, or using bare hands instead of hand tools. taking unsafe position or posture too close to opening and lifting while in awkward position (riding on running boards or other unsafe places of vehicles)

   v). Distracting, teasing practical joking, horseplay, quarrelling or annoying.

   vi). Failure to use safe clothing or protective equipment such as failure to use rubber gloves, helmet or energized equipment.

   vii). Ask subordinate to supervise the work & leave the site.

   viii). Over confident on sub ordinate/machines & tools.

   ix). Non barricading of hazard area.

   x). Non adoption of the practice that all light equipment and tools to be used aloft should be raised and lowered by means of hand line and canvas bucket, other suitable container, and men on the ground should stay clear of overhead work to prevent being struck by falling objects.

   xi). using unsafe equipment or using equipment improperly such as using dull cutting tools or mushroom head chisels, pipe extensions on wrenches not designed for them, wrong tool for the job, using hands instead of hand tools.

xii). unsafe Loading, Placing or Mixing such as overloading cranes and winches, carrying too heavy load, leaving objects where they are likely to fall, improper packing, combining chemicals to form a dangerous mixture.

xiii). failure to use safe clothing or protective equipment such as wearing loose sleeves, neckties, or jewellery near rotating machinery, failure to use rubber gloves on energized equipment and failure to use goggles, helmet, gas masks, respirator, safety belt, ladders or gloves when necessary.

ii. **Unsafe Conditions** which may result in accidents include the following:-

i). Unguarded equipment such as unshielded moving parts of machines, saws, etc. and un-barricaded floor opening and excavations.

ii). Use of defective material or equipment such as mushroomed chisels, split handles, poorly constructed scaffolding, broken ladder, torn gloves etc.

iii). Improper illumination such as insufficient light or unsuitable location producing glare or objectionable shadows.

iv). Unsafe design and construction, such as poor scaffolding and structure, structures like platforms having low safety factors, and their construction and design in general not having required safety features.

v). All anticipated hazards should be pointed out to workers.

vi). A/C, D/C, control cable run together.

vii). power cable for lighting / air compressor / air conditioner being run together with common switch box and with less capacity switches.

viii). Control cable and power cable running together.

ix). Sacrificing safety for speed.

x). The person-in-charge of work failing to ensure himself that the power mains & the apparatus are free from dangerous leakage or induction and has been effectively earthed locally before permitting men to work upon it.

xi). Failure to place warning boards by the person-in-charge on all switchgear before men are permitted to work which should only be removed by the person who has placed them. It is desirable that the person issuing the PTW shall place one warning board on the switch energizing the mains for each permit issued so that he can be sure that all the permits-to-work are returned when he has so charge the mains.

xii). Allowing visitors and unauthorized persons shall not be allowed to remain in the vicinity of live mains and apparatus, unless accompanied by an authorized person whose responsibility it shall be to ensure that his instructions regarding safety are strictly complied with.

CHAPTER – 7

GENERAL INSTRUCTIONS FOR SAFETY

I. RESPONSIBILITY OF INDIVIDUALS

1. Individual responsibility is to act in such manner so as to provide.
   a) Safety to himself
   b) Safety to his fellow employees
   c) Protection to the public.
   d) Protection to the company's property.
2. Every employee is expected to study the Safety Manual, familiarize himself with its contents and apply them to his work. Ignorance of Rules and Regulation will result in accident to him and to his co-workers.
3. Whenever in doubt regarding any rules and regulations, he should consult his supervisor or the person in charge of the work.
4. Before attempting any work under the conditions that he considers being unsafe, bring it to the attention of the person-in-charge of work and seek his advice.
5. It is the duty of every employee to report to his supervisor any dangerous or improper condition of apparatus or equipment which comes to his notice.
6.
   A). Before starting any work on live lines or equipment, the work should be clearly understood by each one.
   B). Workers doing live line work shall devote their attention to the work in hand. Unnecessary conversation with co workers should be avoided.
   C). Where it is necessary for one man to change his working position on a pole or a tower, the other man should not do any work on live conductors until the man has reached his new position.
7.
   A). Place yourself in a safe and secure position to avoid slipping, stumbling or moving backward against live conductors or apparatus. Do not rely for protection upon the care assumed to be exercised by others.
   B). Make a habit of being cautious. Be on the lookout for danger notice plates, danger flags, warning boards and signals, etc. Warn others when they seem to be in danger near live conductors or apparatus.
8. Use of intoxicating liquor or drug and smoking while on job is strictly prohibited. No employee shall report for work while he is under the influence of liquor and Supervisor shall not knowingly permit a man to go to work while he is under the influence of liquor / drug.
9. Practical joking and house play while on the job is strictly prohibited.

10. No employee shall distract the attention of other worker from his job unless he thinks that the worker is doing something dangerous or risky either to his person or equipment.

11. Smoking is strictly prohibited in the areas where it may cause fire hazards. Specifically, in the areas like battery rooms, and locations where the flammable liquid/materials are stored and used or other areas where combustible materials are kept. Absence of "No Smoking" signs shall not be an excuse for smoking in dangerous places.

II. Dress Code

a) Use of overalls, jumpers and coats having metal buttons, metal straps and similar metal fittings should be avoided. Bone buttons may be used. Buttons should be sewed in place with thread. Use of Loose clothing should be strictly prohibited.

b) While working on live conductors, do not roll up sleeves as dry cloth gives some protection against shocks.

c) Do 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 serious, if not fatal, injury.

d) Metal key chains, or metal keepers for key rings or watch chains should not remain exposed the outside the clothing. There is always a possibility that these may come in contact with live conductors or live apparatus.

e) Wear goggles, safety glasses or any other eye protection as instructed by the person-in-charge depending upon the type of work handled, particularly while doing welding job.

PERSONAL CAUTION

It is in the workman's own interest to exercise utmost personal caution as indicated below so as to prevent accidents and injury to him.

1. Every employee should consider the result of each act and no chances should be taken that will endanger workman's own or other fellow worker's life.

2. **Always be Careful** (ABC). The workman should place himself in a safe position while working to avoid falling, stumbling, slipping or moving backwards against live parts.

3. The workman should satisfy himself regarding the safety working condition before starting the work. The care exercised by others should be checked.

4. Before commencing the works he should examine all the required safety equipment like ladders, gloves, strup and rope etc.

5. **Taking chance:** - Before commencing any work that may be hazardous or otherwise, care shall be taken to establish a safe procedure. When more than one employee is engaged in the same job, all employees concerned shall understand the procedures to be followed (tailboard conference)?

   It will be the duty of every employee to report promptly to his Supervisors of any dangerous or improper condition of equipment noticed.

6.

   A). Think carefully before you act. Make sure you are right. Watch out for the other man and make sure he is right.

   B). Never talk to any person working upon live mains or apparatus, unless the person doing the work is aware of your presence.

III. PHYSICAL FITNESS

1. Any employee who is unable to perform his duties due to illness or other disability shall promptly report his condition to his immediate supervisor.
2. After absence from work due to injury, an employee may be required to pass a physical examination to determine his fitness for duty.

GENERAL SAFETY PRECAUTIONS:

IV. House Keeping

Workmen are frequently injured by tripping, stumbling, stepping on or bumping into tools, material and other object, left lying around or by carelessly placed object falling from above.

To ensure good housekeeping the following precautions should be observed:-

1) The place of work, both within the building and around the work area in switch yard, should be kept neat and clean.
2) 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.
3) The storage area should be neatly maintained and the materials should be stored systematically and in an orderly manner to prevent their falling or spreading and to eliminate tripping and stumbling hazards.
4) Clothing or any other types of material should never be hanged behind the space of the neighborhood of substations, pole yards, buildings, oil tanks, or other structures.
5) Pathways, stairways, fire escapes surrounding area near the distribution boards, control panels etc. and all other passage ways shall be kept clear from all obstructions.
6) Tools and materials should not be placed where they may cause tripping or stumbling hazards or where they may fall and strike anyone below.
7) Puddles of oil and water create a slipping hazard hence should be cleaned up promptly.
8) Nails in boards, such as those removed from scaffolds, forms and packing boxes, constitute a hazard and should be removed. The boards should be carefully stacked or stored.
9) Dirty and oily waste rags should be deposited in approved container and disposed off as soon as practicable to avoid fire hazard.
10) Broken light bulbs, glass, metal scrap and other sharp objects should be dumped in place or containers provided specially for them.
11) Discarded fluorescent and other gas filled tubes shall be disposed off safety.
12) Broken insulators or other sharp edged material shall not be left in vacant lots, along the right of way or in the location where the hazard of cutting feet could be caused to men & animals.
13) Line materials, tools or equipment must not be scattered around street sidewalks, highways, etc. but must be kept in a neat orderly manner, where they will not be liable to cause accident.

V. Storing and Piling of Materials:

1. Material stored in quantity should be arranged so that the weight is evenly distributed and not top heavy.
2. All stacks and piles should be protected against over-turning or other movement.

3. Barrels, drums and kegs should be stored on end or securely blocked to prevent rolling.
4. Store the material at adequate/safe distance from the live equipment.
5. As per IE Rule (82A), no material or earth work or agricultural produce shall be dumped or stored or trees grown below or in the vicinity of bare overhead conductor lines so as to reduce the requisite safety clearances specified.

VI. Lifting, Carrying & Hoisting Heavy Objects:

1) Employees should not attempt to lift beyond their capacity.
2) Employees should avoid twisting or excessive bending when lifting or setting down load.
3) Pushing should be resorted to when moving a load horizontally, rather than pulling it.
4) Gripping, Grasping, and Lifting with Just the Thumb or index fingers should be avoided & whole hand and all devices should be used.
5) Employees working at site should wear helmets
6) Manila or sisal rope sling should not be used over sharp metal corners and edges; wire ropes with padding over sharp corners and edges may be preferred.
7) No one shall stand or pass under any suspended load being handled by a crane, derrick.
8) Several work men should not climb at the same time.
9) Some of the dependable rope knots and hitches are shown in the attached sketches, indicating their special purpose and advantage.
10) Safe loads that can be lifted with various sizes of Manila and steel ropes under different hitches are given in the attached chart. The values given are valid for undamaged ropes and when the loads are lifted without jerk. Monofilament and steeple fiber ropes also can be used of special grades only, equipment to that of Manila ropes in respect of breaking load having kept safety factor = 2.
11) Most lifting accidents are due to improper lifting methods rather than lifting too heavy loads. When lifting heavy objects, the back should be kept close to vertical and the lifting done with leg and arm muscles rather than with back muscles.
12) Pipe, conduits, reinforcing rods and other conducting material should not be carried on shoulder near exposed live electrical equipment or conductors.
13) Rope tackle and slings wherever required should be checked to ascertain that they have sufficient strength to perform the work in hand.

VII. Cleaning of Parts:

With inflammable solvents

1) Adequate ventilation must be available to avoid fire explosion and health hazards.
2) Avoid breathing solvent vapors.
3) Keep open flames and sparks away from inflammable liquids and their vapors.
4) Metal nozzle of a hose for spraying flammable solvents shall be grounded.
5) Goggles shall be used when blowing out dust with compressed air.

VIII. Supports & Scaffolds:

1) Do not stand taking support of any structure, pole equipment in the yard.
2) Do not use support for men, material/equipment to poles, scaffolds, Ladder, walkway or portion of tree, and any elevated structure, unless it is ensures that they are firmly secure & adequate enough to take load. Do not stand by taking above support
3) Scaffolding should be checked before use, for its strength, rigidity.
4) The footing and anchorage point for scaffolds shall be sound rigid, and capable to carrying the maxi load without settling or displacement.
5) Carry the scaffolds/ladders carefully in the yard.
6) Scaffolds should not be moved before all the Material/Tools/Equipment removed are from the scaffolds.
7) Employee working on suspended scaffold shall be protected by an independent life line.

IX. Preventing Fires and Explosions:

1) Waste Paper, rages, and other combustible material should not be allowed to accumulate.
2) Inflammable liquid shall be kept / stored in clean & safe place with proper labels.
3) Open flames & Smoking is Prohibited in all places where inflammable liquids, or gases are stored.
4) Employee should be familiar with the location and proper use of fire extinguishers,
5) **By IE Rules 43,**
   a) Fire buckets tilled with clean dry sand ready for immediate use for extinguishing fire in addition to fire extinguishers. shall be provided
   b) First – Aid Boxes or cupboards, conspicuously marked & equipped with all first- Aid material shall be kept.
   c) Two or more gas mask shall be provided.

CHAPTER NO – 8

Personal Protective Equipment (PPE)

The Personal Protective Equipment (PPE) must be provided to the staff working in maintenance & construction activities for protecting them from mechanical & Electrical injuries.

As per **IE Rules 36 Sr. No.1**, Every Person who is working on an electric supply line or apparatus or both shall be provided with tools & devices (Personal Protective Equipment) for protecting them from Mechanical & Electrical injuries.

As per **IE Rules 44 Sr. No.4**, in every Manned EHV Sub-station, an artificial respirator shall be provided and kept in good working condition.

The following is the **minimum requirement** of safety devices & special tools (Personal Protective Equipment) to be provided to individual.

a) Rubber Gloves
b) safety Shoes
c) Safety Belt
d) Ladder
e) Earthing devices
f) Helmet
g) Line tester
h) Ropes
i) Hand tools like pliers, screwdriver etc.

I. GENERAL INSTRUCTIONS:

1) It is the responsibility of the employee to make use of safety device properly.

2) Tools/Equipment must be stored in safe place after the work is over.

3) The use of the equipment/tools must be made mandatory while working. The supervisor should see that the workers are using the tools/equipment at work place.

4) The Person–in–charge of the work should ensure proper maintenance and use of the safety equipment. The tools/ equipment shall always be maintained in sound & efficient working condition.

5)
   a) All safety equipment, safety rubber, gloves, safety shoes/ boots and galoshes shall be inspected periodically
   b) Any safety device found defective on inspection shall be repaired / replaced immediately; if it is not possible to effect repair replacement, the defective ones shall be discarded at once.

6) Pliers and other tools insulated with brittle material or otherwise liable to have the insulation damaged, when in use, shall not be used.

7) The supervisor in charge of the work will be responsible to test and ensure proper use of the safety equipment supplied to the gang of workmen under him and see that it is maintained at all times in efficient condition and must immediately bring to the notice of his superior / officer regarding equipment which is liable to be unsafe and arrangements should be made immediately for their replacement.

8) Rubber gloves should not be rough handled so as to be damaged. After the work, they should be cleaned, and powdered with French chalk and stored in a safe place.

9) Rubber equipment should be kept clean and free from oil. They should not be stored near a source of heat, or exposed unnecessarily to sun's heat. They are best stored in protective container and should not be tied by cords or threads which may cut it.

10) Safety belt should be properly handled, and periodically treated with oil to prevent it from becoming hard. Care should be taken to see that sharp tools or edges do not cut dents and holes in it. Extra holes should not be punched as it weakens the belt. It is best preserved in a separate case.

11) Rubber gauntlets, gloves, boots and galoshes shall be inspected periodically.

II. LADDERS

a) Ladders must be of strength to carry double the strain of the heaviest load that would be placed upon them.

b) Defective ladders must never be used.

c) When straight portable ladders are used on hard surfaces, they must be held or firmly locked. In addition, anti slip shoes must be used where provided.

d) A ladder shall not be placed against an unsafe support.

e) Ladders must be kept free from dirt, grease, and paint spots.

f) Ladders must be stored upon brackets and in sheltered locations.

g) Ladders should never be left in place when employees leave the worksite for an extended period of time. They shall be laid on the ground or floor in a safe location or kept in the storage position.

h) Two ladders must not be spliced together.

i) Employees must face ladders when ascending or descending over them and must have both hands free for gripping the ladder.

j) Employees must not slide down or try stunts on ladders. Ladder must be periodically inspected; when found defective; they must be repaired or disposed off. Ladders with weakened, broken, or missing steps, broken side rails, or other defects shall be repaired or removed from service.

k) Straight, portable ladders must be placed at safe angle about 75 degrees with the horizontal. In other words, place the foot of a 12'/4mtrs ladder 3'/1mtr from the object it leans against.

l) Straight ladders shall not be climbed beyond the third step from the top.

m) Employees shall use the safety belt tied to the ladder whenever both hands must be used for the job or a possibility of the employee falling from an elevated position exists.

n) As far as possible, portable metal ladders shall not be used in the vicinity of exposed energized lines and equipment.

o) Ladders are not meant to be used as scaffolding platforms.

p) Other makeshift arrangements for the purpose of ladders like using boxes, chairs, etc. shall not be resorted to.

q) Use of step ladders above 6 meter is prohibited.

r) When an employee is working on a step ladder more than 10 feet high, the ladder shall be held by another person.

III. Ropes

a) Fiber ropes are made principally of manila fiber or, sisal fibre and hence frequent inspections are required in the use of rope as the interior fibers may be broken or trend to powder, while the exterior fibers may indicate that the rope is little worn.

b) Pure manila rope is the strongest and most reliable of fiber ropes. It is of yellowish color with silvery or pearlish luster and has a silky feel when drawn through the hand. Rope with brown or black fiber is of inferior grade.

Sisal rope has about 6.7% of the strength of manila rope. It is yellowish white, sometimes with a greenish tint. The fibers are hard and stiff, with a tendency to splinter.

Hemp rope is nearly as strong as manila and is slightly more resistant to atmospheric deterioration. It is of dark grey color and is much softer than manila rope.

c) Rope must be so uncoiled as to avoid kinking, since even a moderate strain on a rope in which there is a kink may over stress the fibers at the kink. Wet rope deteriorates rapidly unless dried properly. It should be hung up in loose coils so that dry air can be circulated through them. Heat should never be applied as it dries out the oil and thus shortens the life of the rope and has a tendency to form kinks. No load should be applied until all kinks are removed.

All ropes are easily damaged by acids/alkalis. Any rope known to have been exposed to acids or alkalis (sometimes indicated by discoloration or strains) should be used with caution.

d) In making a rope fast, an object with a smooth round surface should be selected. When rope is running over a sheave or pulley, internal wear is caused by friction. The life of the rope is greatly prolonged by using blocks with sheaves of large diameter.

e) Fiber rope should always be cleaned before placed in storage and shall be stored in a dry, airy place. It should never be stored in the same room with acid or caustics.

IV. Hand Tools:

a) All tools shall be of an approved type.

b) Tools shall be inspected at frequent intervals and disposed off as soon as the sign of damage is observed.

c) Using hand tools improperly, neglecting to keep them in safe working condition and carelessly leaving them around where they may endanger persons to trip or stumble are frequent causes of accidents. Proper tools should always be used for the work.

d) All tools shall be maintained in good working conditions. Burred heads shall be promptly redressed. Broken, cracked or otherwise damaged handles shall be replaced. All tools with sharp edges should be kept in sheaths, shields, tool chests or other containers, when not in actual use.

e) A screw driver should never be used as a chisel. Screw drivers with full length metal tong or shank through handle must not be used for electrical work. Other tools such as pliers, wrenches, etc. whether insulated or not insulated shall not be used without rubber gloves while near live parts of any voltage.

f) All files shall be fitted with substantial handle; workmen should keep files cleaned as this reduces the slipping hazard and prevents skinned hands.

g) Never use metal tapes, rulers, cloth tapes with metal strands, wood rulers with metal ferrules or joints near energized equipment.

h) Hammers with metal handles shall not be used on or near energized electrical circuits or equipment.

i) Tools shall not be thrown from places or from person to person.

j) Tools shall never be placed unsecured on elevated places.

k) Chisels, drills, punches, ground rods, and pipes shall be held with suitable holders or tongs (not with the hands).

l) Shims shall not be used to make a wrench fit.

m) Pipe shall not be used to extend a wrench handle for added leverage unless the wrench is designed for such use.

n) Wooden handles that are loose, cracked, or splintered shall be replaced. The handle shall not be taped or lashed with wire.

o) All cutting tools such as saws, wood chisels, drawknives, or axes shall be kept in suitable guards or in special compartments.

p) When using such tools as screwdrivers and wrenches, employees should avoid using their wrists in a bent (flexed), extended, or twisted position for long periods of time. Employees should maintain their wrists in a neutral (straight) position.

V. Portable Electric Tools

a) All portable electric apparatus shall be regularly examined, tested and maintained to ensure that the apparatus and leads are in good order.

b) Ensure that all portable appliances are provided with 3-pin plug and socket connections and that the metal work of the apparatus is effectively earthed.

c) All loose wiring, such as flexible cables for portable lamps, tools and trailing cables and other portable and transportable apparatus shall be tested regularly at frequent intervals to ensure safety.

CHAPTER – 9

Safety Documents (Permit System)

Safety is ensured by following certain well defined Policies, procedures and methods during construction, operation & maintenance. The objective of safety documentation system is to ensure that written instructions & guideline are available and are to be followed.

Safety document system is an essential part of safety management by following safety Rules/Procedures & precautions so that the safety is ensured.

These Rules/Procedures & precautions are documented and the documents are issued by the Shift in Charge with strict instructions to be followed up at appropriate stage. (With the signature and seal)

These safety documents are also useful in investigation of accident.

Following as are the written documents. To be maintained by the Sub-station in Charge.

1) Permit to Work Book-PTW (Annexure – I)
2) Sanction for Test-SFT (Annexure – II)
3) Electrical Inspector for Charging Permission.
4) Authorization Chart
5) Office Record:
   a) Log Book, Log Sheet
   b) Site Test Report
   c) Factory Test Reports
   d) Tripping Register
   e) Equipment maintenance Register / Maintenance Schedules / Safety Audit.
   f) Inspection Register / Record.

I. As per IE Rule 63 Sr. No.3

The owner of any High or Extra – High voltage installation who make any addition or alteration to his installation shall not connect / supply his apparatus or Electric line comprising some alternation or addition unless and until such alternation or addition have been approved in writing by the Electrical Inspector.

II. Authorization Chart as per IE Rule 3 Sr. No.3

No person shall be deemed to be authorized under sub-section (1) unless his name has been entered in the list maintained at the office or premises of the person authorizing him and giving the purpose for which such person is authorized and the entry has been attested by the authorized person and the person authorizing him.

Every list maintained under sub-rule (3) shall be produced before an Inspector, when required.

III. IE Rule 46 Sr. No.1

Every such Installation shall be periodically inspected and tested at interval not exceeding five years.

IV. IR Rule 65 Sr. No.6

Record of all tests, trippings maintenance works, record of all equipment & supply line shall be duly kept in such a way that these records can be compared with earlier one.

V. As per IS 5216 Part I Sr. No.4

V.1. All Messages and instructions relating to the operation of switches and other important communication concerning the work shall be recorded in the register of Messages.

V.2. The issue of permit shall be entered in the log book or log sheet either in red ink or should be under -lined.

VI. IE Rule 65 Sr. No.1.

Before approval is accorded by the Inspector under Rule 63, the manufacturer's test certificate shall, if required, be produced for all routine tests as required under the relevant Indian Standard.

Permit System

I. Permit System (General Instructions)

1) The written document 'Permit to Work' shall be issued for safe working & precautions to be taken at work spot.

2) Permits for work shall be applied by an authorized person to take line clear and shall be issued by the Engineer (or competent person in charge of operation) in writing in the form prescribed.

3) The work spot may be far away from the switching sub-station. Hence the Permit to work shall be issued with the necessary precautions to be taken at the work spot.

4) No employee shall carryout or attempt any work on live apparatus or work in proximity of open conductor unless the supervisor has necessary permit to work, issued by competent authority.

5) No person shall carry out or attempt any work on live mains or apparatus except with a permit-to-work and under the direct supervision of a competent person.

6) The special instructions to provide safe working conditions shall be rigidly complied with by all persons and at all times when working on a job with a permit-to-work. Any one disregarding this instructions or behaving in a manner likely to cause danger, either to himself or to anyone else, should be properly punished.

7) The person-in-charge of work shall explain the nature and duration of work to be carried out to the permit issuing authority, and obtain from him a permit-to-work before commencing any work.

8) **Application for Pre-arranged shutdown**: Except for emergencies, all works for repairs, maintenance and construction on or in close proximity of live apparatus and mains, shall be prearranged and programmed. Accordingly, applications for prearranged shutdowns shall be submitted by the Supervisor to the Officer in charge, in the prescribed form, vide appendix V which when duly approved, will be presented to the concerned Permit issuing Officer for switching off the apparatus and issue of permit–to–work. These applications shall be made sufficiently in advance to enable the permit Issuing Officer to carry out necessary load management, if any and other operations connected with the work. The duration and

nature of the work must be clearly explained to the Permit Issuing Officer before getting a permit.

9) Issue and return of permit shall only be in person or on PLCC (sub-station) equipment & not on mobile or landline phone.

10) In case of Issue & return of permit on phone, the in charge of the shift shall confirm by cross check, the phone number & voice of the supervisor.

11) Where written permits cannot be issued / taken in person, 'line clear' should be issued / taken on phone. In such cases, massage thereof. Shall be repeated by the person who receives the 'line clear' permit and shall be confirmed by the sender of the massage to ensure that both parties are quite clear as to its purpose. Such instructions shall be recorded in specially maintained 'line clear' permit books at both ends. The duplicate copies of the line clear permits should be sent by post as soon as possible for record after duty cancelling the same. These books should be periodically reviewed by the AM/Dy.M.

12) Permit book should be treated as an important record. The sheets and the books themselves should be serially numbered. No page should be detached or used for any other purpose. If any paper is inadvertently detached then dated and initialed statement must be taken and recorded in the book by the person responsible for it.

13) The same person who takes the permit should return it. Even the issuer and the receiver of a permit is one and the same person, a permit should be issued as self permit and cancelled after the work is over. This procedure should be rigidly followed.

14) Permits taken in person can be returned over phone. However, the procedure outlined under reference should be followed as far as applicable.

15) A system of code words may be adopted for permits issued and returned over phone.

16) Whenever a worker is working on line alone, he should follow the self permit system. The permit format is enclosed.

17) The sample formats in English and Assamese are enclosed vide Annexure, on page Nos. 38, 39, 40 & 41.

18) Confirm that the permit is signed by issuing authority & permit taking person.

19) An entry is made in the Log Book or Log Sheet to the effect that the mains and apparatus under permit have been made dead. On no account, the same shall be made alive until the permit is returned by the person-in-charge of work.

II. Special Instructions to Supervisors

1. The person-in-charge, before allowing any workman to commence work on the mains and apparatus/line, shall take the following precautions:

a) Explain the nature of work and the precautions taken by the permit issuing authority to ensure the safety of the workmen and also the precautions to be taken by them during the progress of the work;

b) The circuit breakers of line / apparatus have been opened correctly and line / equipment has been isolated, discharge properly, earthed where ever possible and tested with a discharged rod and that danger notice plates have been placed at appropriate places;

c) Warn the workmen and public of the danger that exists in the vicinity of the area covered by the permit.

d) Where work is to be carried out on live or medium voltage mains or apparatus, the following additional instructions shall be complied with:

e) On completion of the work, remove all earthing devices so that the mains and apparatus are fit in all respects for charging; withdraw all workmen and warm them that it is no longer safe to touch or approach the mains and apparatus, and thereafter return the keys and the permit to the shift incharge for cancellation.

f) The instructions shall be read out and explained to the workmen in the language they understand, and copies shall be pasted on the various notice boards. Ignorance of the instructions shall not be accepted as an excuse for non-compliance with them.

g) No employee shall be ordered or permitted to carry out any work, other than that for which he is specially authorized in writing by the AGM, AM / JM.

h) The Supervisor in charge of a work shall keep with him a complete list of all persons who are working on the particular job. All other persons shall be warned to keep away from the area.

i) The supervisor, before allowing any Workmen to commence work on the lines, mains or apparatus.

Create a safety zone by short circuiting together all the conductors and adequately earthing on both sides of the place of work.

III. PRECAUTIONS TO BE TAKEN WHEN WORKING WITH A PERMIT

a) On equipment in the sub-stations.

It is also the duty of the holder to check whether the equipment/line has been properly earthed.

The staff member shall be informed

a) On which equipment/part of equipment where it is safe to work
b) The Area where it is dangerous to work shall be barricaded by ropes & flags.

When men have to climb up structures or apparatus which bring them under reduced clearance to live parts, the authorized person shall be present at site and direct the work.

b) Overhead line

1) Before touching the conductors, each conductor shall be discharged and connected well to earth by means of discharge rods.

2) This shall be done at two points on each side of the place of work. In addition, the conductors should be earthed on towers (or poles) on which work is actually carried out, as per standard practice.

The work on one of the circuits of a double circuit line shall be carried out in accordance with the following regulations.

a) The minimum distance from the conductors of the live circuit and where the men working on the (dead circuit) shall be ... 2400 mm & above.

b) Only minor works of the nature of placing insulators, binding etc. may be done when the other circuit is alive. Works such as stringing conductors etc. involving greater risks may be done under special circumstances and under the personal supervision of the competent authorized or Hot line maintenance officer specially deputed for such purpose.

IV. Transfer of Permit

a) Transfer of permit to work from one Supervisor to another is strictly prohibited. If there are more than one working parties, separate permits should be issued to the Supervisor in charge of each working party and a written record should be kept of the number of such permits issued for each work.

b) If work is of such a nature and duration that it has to be carried out continuously but under the supervision of more than one Supervisor in shift duty, the "Permit to work" form shall be endorsed by the Permit Issuing Officer cancelling the name of the supervisor to whom it was originally issued and substituting the name of the second or subsequent Supervisor to whom the permit will now become valid. The time of each endorsement should be noted on the "Permit to work" form and it's duplicate.

V. Logging of Permit Issue and Return

1) The Issuer of the permit shall carefully log the various operations performed by him in connection with the issue and return of permit in the daily main station log book and the sequence in which the operations are done.

2) The operation reported to have been done by other side stations or in connection with the issue or return of a permit shall also be logged.

3) The issue and return of the permit shall be logged in the book in red ink.

4) When change of shift occurs during the pendency of a permit, the outgoing in charge shall specifically orally inform the incoming incharge operator as well as by logging in handing over note, regarding the permit which is pending. The incoming in charge operator shall also note the pendency of the permit.

5) No line or equipment should be made again live until the permit issued on it, is returned.

6) The same person who takes the permit should return the permit.

Switching Operations:

I. General

1) Every telephone message relating to switching operations of high voltage system shall be written down. Every such message shall be repeated in full to the sender to ensure that the massage has been accurately received & understood.

2) A record of high voltage switching operations will be entered in station logs.

3) The permission of **SLDC Kahilipara** is essential for any switching operation in EHV S/Station.

4) If the circuit is controlled by an auto reclosing, the reclosing mechanism shall be made inoperative.

5) Interlock system should not be made inoperative unless authorized by the Engineer-in-charge.

6) If, during a switching operation, a piece of Equipment shows any sign of distress, switching must cease immediately and the Shift In-charge should be informed. All persons must be warned that a potential hazard exists.

7) No Back Feed permit must be obtained from all concerned stations. The details of the No Back Feed Permit must be entered in the substation logbook along with message number, date and time. The message number, date and time must be recorded on the PTW/SFT.

8) Danger signs should be displayed.

9) Unauthorized person should not be allowed inside a hazardous operation area like a bus compartment, switchyard etc. unless such a person is accompanied by a responsible person.

10) When carrying ladders, pipes, conduits, reinforcing rods and other long material into stations/switch yards, bus compartments rooms and other places where there is danger of touching it to live parts, the material should be held by two men, one at each end and carried in the hands and not on the shoulders.

11) Care should be taken to prevent clothing, wiping clothes, waste dusters, oil cans or tools from catching in the moving parts of machinery.

12) When using compressed air on electrical machinery an insulating hose and nozzle should be used. Dust proof goggles should always be used when cleaning with compressed air. Compressed air should never be used for cleaning or dusting cloths or any part of the body.

13) All employees shall be familiar with the use of fire extinguishing apparatus, locations of the apparatus, sand pails, water hoses, etc. The fire extinguishers shall be suitable for use on or near Electrical equipment. Soda acid extinguishers should never be used on electrical fires

II. Taking the Line / Equipment out of service

1) The load on line must be recorded before switching off.

2) In case of Parallel line / equipment, the anticipated load transfer after switching shall be judged and accordingly the decision regarding switching shall be taken.

3) The authorized person who is going to supervise the work must be ready to take permit / and he shall apply for permit.

4) After obtaining permission from **SLDC Kahilipara** inform the other end S/S shift in charge accordingly.

1) **In case of shutdown on line/Transformer.**

   a) Ensure that the Circuit Breaker of the associated line is open first and confirm all the three poles are open.

   b) In case of line also confirm that other end Circuit Breaker is open

   c) In case of transformer, confirm that all three poles of L.V. side C.B. are open & then H.V. side breaker shall be opened ensure that all three poles are opened.

2) Open both side Isolators (Line & Bus side) & make sure that all the three poles are opened perfectly.

3) Confirm that Isolators are opened at other end also.

4) The line/transformer should be earthed by using earthing switch and discharge Rods. The discharge rods while earthing should not come in induction zone of live line /Bus/Equipment.

5) In case of line, No return permit shall be taken on phone from other end side S/S. Substation Shift in charge.

6) The "Permit to Work" ('Line clear' permit) shall be issued to authorize person/staff to work on the line/equipment with necessary instructions regarding taking precautions while working at work spot.

III. Taking the line / equipment into service.

1) Confirm that all permits issued on line/equipment have been received for cancellation.
   a) The supervisor shall give following details & sign the permit before submitting it for cancellation.
   i). The details of work carried out during the outage.
   ii). The confirmation that workers those who are working are out from the work spot.
   iii). The confirmation that Temp earthing provided by the supervisor is removed.
   iv). The confirmation that All T&P/ instruments are kept aside of working area.
   v). The confirmation that it is Safe to take line/equipment in to service.
2) Inform the SLDC Kahilipara & other end substation in charge regarding cancellation of permits.
3) **In case of line**: Return the permits takes from other end shift in charge & ask him to open the earth switch to remove discharge rod.
4) Open the earth switch & Remove the discharge Rods at local end.(Earth blades be painted in Red radium color to identify the opening open action)
5) Close both side Isolator & confirm that the Isolators (three poles) are firmly closed.
6) Inform SLDC Kahilipara and take permission to charge line breaker & inform other end side shift in charge accordingly.
7) Close the Breaker, if it stands then inform other side shift in charge and ask him to take line in to service.
8) If the line does not stand ok, check circuit breakers / switch yard & if everything found normal &, if permitted by SLDC, take trial otherwise inform the substation in charge accordingly to take necessary steps.
9) In case of power transformer / substation yard equipment
   a) Confirm that all permits issued are cancelled.
   b) Remove temporary earthing discharge rods.
   c) Close both side isolator & confirm that all three poles are closed properly.
   d) Inform the SLDC regarding operation & take permission for charging.
   e) If permitted, close H.V. side Breaker and after a period of 1-2 minutes, charge L.V. side breaker.
   f) Inform SLDC regarding operations.

Safe working in the sub-station:-

1) Station:-

I) Danger signs should be displayed to warn persons the presence of high voltage equipment.

II) Gates in switchyard fences, other enclosures containing live equipment should be kept locked at all times except when men are working inside.

III) Unauthorized persons should not be allowed inside a hazardous operation area like a bus compartment, switchyard etc. unless such a person is accompanied by a responsible person who shall always be present while such person remains in the area. Any person deputed to clean the floors or parts of the plant in such areas must be given clear instructions and a responsible person must be present while the man is carrying out the work to ensure that the man does not endanger his own safety.

IV) Before doing any work on rotating equipment, it should be shut down and properly disconnected from power source.

V) Care should be taken to prevent clothing, wiping cloths, waste dusters, oil cans or tools from getting caught in the moving parts of machinery.

VI) When using compressed air on live electrical machinery, an insulating hose and nozzle should be used. Dust proof goggles should always be used when cleaning with compressed air. Compressed air should never be used for cleaning or dusting clothes or any part of the body.

VII) If men are working on H.T. (voltage above 650V) equipment, the area safeguarded for work shall be cordoned off by tieing a white rope or cotton tape all round and danger boards shall be fixed within the safe guarded area at various location with the inscription facing the safe working area to warn the men not to cross over the area with live equipment during the progress of work.

VIII) It should be ensured that maintenance and repair works are done promptly before the equipment deteriorates further and become a source of danger. It shall be also ensured that defective equipment is not retained in operation till they are rectified.

IX) It should be ensured that the appropriate and proper tools are used for maintenance and repair. These tools should be periodically checked and if defective, must be rectified before using them again or condemned, if beyond repairs.

X) Live disconnecting switches and fuses should not be opened or closed by any other means than the stick or operating gear provided for this purpose. The person using the switch stick should ensure himself of a secure footing and proper clearance from other equipment and should wear rubber gloves of adequate insulating value for the voltage of the disconnecting switch or fuse and in good condition.

2) TRANSFORMERS:

i). When work is to be carried out on a transformer, both the low and high tension (Primary & secondary sides) breakers and isolator shall be opened. Similarly when isolating transformers to which potential transformers are connected, such potential transformers shall be isolated and secondary P.T. fuses removed to prevent any possibility of transformer being made alive through synchronizing or voltmeter plug.

ii). Before commencing any work on a transformer, the transformer winding should be discharged to ground. In case the transformer is isolated from the supply by single point of disconnection e.g. fuse, the transformer shall be safeguarded by shorting the phase terminals together and connecting them to ground, before commencing any work. The neutral ground of a transformer should never be treated as the grounding of phase terminals, as required above.

3) Instrument Transformers:

i). The instrument transformers should be grounded.

ii). One lead of the secondary circuit of the current transformers should be connected to ground at all times when the C.T. is in service.

iii). Potential transformer secondary should never be shorted to ground except star point.

iv). The low voltage winding of potential transformers should always have one side permanently and effectively grounded.

4) Capacitors

i). Every capacitor shall be treated as 'hot' until proved otherwise. Capacitor's store energy and are not necessarily dead when disconnected from the lines. Once charged, a capacitor may retain this charge for several hours after it has been disconnected.

ii). Before commencing work on the capacitors, first open all cut-outs or disconnecting devices to the capacitors, then wait for at least five minutes for the internal resistor to reduce the voltage. Next using a hot stick, short circuit and ground all terminals of the capacitor. The short circuit grounding jumpers should be left attached while work is being done on the capacitor.

iii). To place the capacitor banks in service, first remove the jumpers with hot sticks, and then close the cut-outs.

D/C distribution:-

1) D/C Distribution Board (DCDB) / Battery Charger must be cleaned regularly. Connections must be Tight / Rigid.

2) Only H.R.C. fuses of adequate and correct rating shall be used. Maintain the stock in the substation site store.

3) On DCDB, every DC feeder DC Cable provided for bay shall be named separately.

4) Separate Room shall be provided for DC distribution system in the substation.

5) AC power cables & DC control cables shall be run separately in cable Trench as soon as possible.

6) Do not pull out the control cables with force & Jerk.

7) The defective cable shall be removed from Trench. Both ends of the cable must be made free first, pull the cable gently/smoothly, without disturbing other live cables.

EHV substation shall maintain following T&P (minimum) for safe working.

a) Ten sets of discharge rods.
b) Good quality Torch (4nos) with fresh cells
c) First Aid Box
d) Tool Box (2nos) containing Insulation, Tape, all size ring & flat spanners, Allen key set, pliers (big, small size) Insulation cutter etc.
e) H.R.C. fuses of various capacities.
f) Ladder (4nos.)
g) Rope
h) A/C Distribution Board with adequate wiring set.
i) Tong Tester.
j) Megger (5kv)
k) Multi meter with cords.
l) Danger Boards.
m) Good quality rubber (hand) gloves

n) Helmet

For fast and effective communication (in case of accident), the following phone numbers shall be readily available.

1) **Police station of concerned Area.**
2) **Ambulance service**
3) **Govt. Hospitals (near to S/S)**
4) **Fire brigade station**
5) **Electrical Inspector.**
6) **SLDC**
7) Mobile number of following persons.
   (a). **Substation in charge**
   (b). **Ambulance service**
   (c). **Fire brigade.**
   (d). **Security head/person.**

Annexure – I

ASSAM ELECTRICITY GRID CORPORATION LIMITED

SUBSTATION_____ Date_____

PERMIT TO WORK

Permit No_____

I. **REQUEST:**

1. Work area:
2. Work to be done:
3. Period of PTW : (From)_____ (To)_____
4. Details of isolation required:
5. Precautions taken to achieve Safety:
6. Name and number of persons to execute work:
7. PTW

(Requested by)

Signature :
Name :
Designation :
Date & Time :

(Approved by)

Signature :
Name :
Designation :
Date & Time :

II. **ISSUE**

1. Sequence of Isolation:

i)

ii)

iii)

2. PTW allowed. (From)_____ (To)_____
3. Further precautions to be taken to achieve Safety:
4. Details of Safety keys issued:
5. Work area is isolated and it is safe to work on:

Signature :

Name :

Designation (Shift Engineer) :

Date : Time:

Note:

1. PTW request to be approved by Resident Engineer/Substation Incharge
2. PTW to be issued to AEGCL JM / executive only.
3. Earthing to be done at the place of work.
4. Colour codification: 1st & 2nd copy of PTW will be light Pink, white respectively.
5. Auto Reclose switch of charged circuit to be kept in Non Auto mode in case of Shut Down (SD) of one circuit of Double Circuit / Multi Circuit line and during PID / Hot line maintenance.
6. In substations where the Reactor is connected to the line before line isolator, the Reactor of dead line is to be isolated before closing Line earth switch in case of S/D of one circuit of D/C line.

RECEIPT:

I* hereby declare that I* have inspected and have satisfied myself that such equipment has been switched off and isolated, where the work is to be carried out. I* also accept responsibility for carrying out work on equipment detailed in this permit and that no attempt will be made by me or by any man under my control, to carry out work on any other equipment PTW.

*(In case requesting official is not physically present, official nominated by Substation in-charge)

Signature :

Name :

Designation :

Date : **Time:**

RETURN OF PERMIT TO WORK

1. Details of Work done:

2. Restrictions, if any, on the equipment being Returned to Service:

3. Clearance

I hereby declare that all men and material have been withdrawn and warned that it is no longer safe to work on the equipment specified in this permit and all tools and additional earths are clear and equipment is ready for charging.

Signature :

Name :

Designation :

Date : **Time:**

III CANCELLATION OF PERMIT TO WORK:

1. PTW cancelled and entry made in PTW register on Page No_____

2. Sequence of Normalization:

i)

ii)

iii)

iv)

v)

vi)

Signature :

Name :

Designation :

Date : **Time:**

Annexure – II

ASSAM ELECTRICITY GRID CORPORATION LIMITED

SUBSTATION_____ Date_____

SANCTION FOR TEST

Sanction No_____

I. **REQUEST:**

1. Test area:
2. Test to be carried out:
3. Period of SFT : From (Date/Time)_____To (Date/Time)_____
4. a) Details of isolation required:

   b) Details of **SAFETY KEY** required:
5. Precautions taken to achieve Safety:
6. Name and number of persons to execute work:
7. **SFT**

(Requested by)		(Approved by)	
Signature	:	**Signature**	:
Name	:	**Name**	:
Designation	:	**Designation**	:
Date & Time	:	**Date & Time**	:

II. **ISSUE**

1. Sequence of Isolation:

i)

ii)

iii)

2. SFT allowed. From (Date/Time)_____To (Date/Time)_____
3. Further precautions to be taken to achieve Safety:
4. Details of Safety keys handed over:

5. Test area is isolated and it is safe to carry out test:

Signature :

Name :

Designation (Shift Engineer) :

Date : Time:

Note:
1. SFT request to be approved by Resident Engineer/Substation Incharge
2. SFT to be issued to AEGCL JM / Executive only.
3. Earthing to be done at the place of test.
4. Colour codification: 1st & 2nd copy of PTW will be light Green, white respectively.
5. Auto Reclose switch of charged circuit to be kept in Non Auto mode in case of Shut Down (SD) of one circuit of Double Circuit / Multi Circuit line and during PID / Hot line maintenance.
6. In substations where the Reactor is connected to the line before line isolator, the Reactor of dead line is to be isolated before closing Line earth switch in case of S/D of one circuit of D/C line.

Caution: SFT should not be issued if any PTW is pending on the same isolated zone.

RECEIPT:

I* hereby declare that I* have inspected and have satisfied myself that such equipment has been switched off and isolated, where the test(s) to be carried out. I* also accept responsibility for carrying out Test(s) on equipment detailed in this SFT and that no attempt will be made by me or by any man under my control, to carry out work on any other equipment .

*(In case requesting official is not physically present, official nominated by Substation in-charge)

Signature :

Name :

Designation :

Date : **Time:**

RETURN OF SANCTION FOR TEST

1. Details of Tests Carried out:

2. Restrictions, if any, on the equipment being Returned to Service:

3. Clearance

I hereby declare that all men and material have been withdrawn and following exceptions are recorded.

Signature :

Name :

Designation :

Date : **Time:**

III CANCELLATION OF SANCTION FOR TEST:

1. SFT cancelled and entry made in PTW/SFT register on Page No_____

2. Sequence of Normalization:

i)

ii)

iii)

iv)

v)

vi)

Signature :

Name :

Designation :

Date : **Time:**

CHAPTER: 9.1

Safe Working in Lines

General Safety Precautions:

1. Before climbing an elevated structure every employee shall first assure himself that the structure is strong enough, sustain his weight safely.
2. If poles or cross arms are apparently unsafe because of decay or unbalanced tensions of wires on them, they shall be properly braced or guyed before they are climbed on.
3. In choosing the climbing side, the side of the pole where the ground wire is attached should not be used.
4. Linemen shall wear their safety belts while working on the poles and towers.
5. Wire hooks shall not be attached to linemen's belts or safety straps
6. Safety straps should be placed above the top cross arm when it is at the top of the pole.
7. Linemen's tools should be so secured that they will not fall out of the tool belts. A lineman should carry only the minimum number tools in his belt. All other tools should be kept on the ground until they are required and then raised by means of a material bag attached to a hand line.
8. All light equipment and tools to be used aloft should be raised and lowered by means of a hand line and canvas bucket, or other suitable container. Men on the ground should stand clear of overhead work to prevent being struck by falling objects.
9. Tools and materials should not be thrown from the ground to a line man working aloft, nor should lineman throw tools and materials from working place to the ground.
10. Broken insulators or other sharp edged material shall not be left in vacant lots, along the right of way or in the location where the hazard of cutting feet could be caused to men or animals.
11. A leather belt should be used when working on overhead locations, In its absence, belts of flexible hemp or manila rope may be permitted round the waists of the workman and tied to cross arm or pole as an alternative to the use of leather belt, under exceptional circumstances. The ropes should be kept in good condition and scrapped when not safe. It is necessary that the tension on the rope is twisted round the pole once or twice in order that release of tension on the pole may not cause it to slip down the pole.
12. One responsible officer (Supervisor/Engineer) should be present to ensure that the safety precautions detailed in schemes 1 to 5.
13. The "**CIRCUIT UNDER SHUT DOWN**" board as per PTW should be present at the working location(s) fixed with the help of a circuit plate or any other reliable method.
14. All linemen who work on the transmission towers, conductors or fittings, shall wear and make use of all safety belts/harnesses and other safety equipment provided for their safety and protection.
15. One green flag shall be attached at the Anti-climbing device level. One green flag shall be attached at each conductor cross arm level. All these green flags shall be attached to the side of the tower that supports the circuit under shutdown.
16. 16. Six red flags should be attached in the center line of the tower at cross arm level to identify the danger zone of the live circuit.

17. The above green and red flags should be attached to all towers on which linesmen are likely to climb.

18. Safe Electrical Clearance shall be maintained by all linesmen until all the additional earths are correctly connected to conductors or jumpers of circuits under shut down.

19. After completing the work, all tools, plant and material shall be removed from the conductors and fittings. The last lineman shall remove the line end clamps from the conductors/jumpers sitting or standing at the point of connection of these additional earths to the tower/cross arm side. After that the earth end clamps shall be removed. This procedure shall be repeated for the disconnection of all other additional earths.

20. While coming down from the tower, the linemen will remove the red flags and the green flags.

I. WORKING ON DEAD LINES AND EQUIPMENT

GROUNDING OF LINE AND EQUIPMENTS

1) Before doing any work on dead lines or equipment where there is a possibility of their becoming energized from any source, such line or equipment should be grounded between the location of work and all possible sources of energy.

2) Before grounding apparatus or conductors, it shall be ensured that the corresponding disconnectors/Isolators are actually open.

3) Temporary grounding cables shall be flexible standard copper/aluminum of size not less than No.1/0 AWG (0.590 inch) and shall be equipped with approved clamps at each end.

4) Grounding cables should be inspected before each use.

5) When grounding lines or equipment, the connection to the ground shall be made first and that to the circuit or equipment last. In removing grounds, first remove the connection to the circuit or apparatus and then remove the ground connection. Approved discharge rods should be used in making ground connection to the circuit apparatus.

6) Grounds shall be placed on all phases even if work is to be carried out on one phase only. While placing the ground discharge rod, it is to be held inclined such that the grounding cable hangs at least 610 mm away from the person.

7) For work on the line, grounds shall be placed at the nearest tower/pole on each side of the points of work, but in no case should earths be more than six spans apart. As an additional safety measure if possible, in addition to above grounds, line should also be grounded on the tower/pole where the work is to be carried out.

8) When work is to be carried out on lines of all insulated construction and grounding point is not provided at point of work, temporary grounds shall be connected at point of work to an efficient portable earth spike driven into the ground. The line shall also be grounded at the nearest line grounding points on either side of the point of work.

9) Where two or more crews are working independently on same line or equipment, each crew shall properly protect themselves by placing their own local temporary grounds.

10) Conductors used for temporary grounding shall be kept clear of the working area and the workmen should be warned not to handle these conductors without adequate safety precautions while they are connected to H.T. equipment or lines.

11) Rubber gloves should be used on both hands when operating discharge rods.

II. WORK ON DOUBLE CIRCUIT OVERHEAD LINES WITH ONE CIRCUIT LIVE

1) To distinguish a dead circuit from a live one, green flags should be fitted on the tower/poles. Flags of any other color shall not be used for indicating a dead circuit.

2) Flags will be removed only after work is finished and temporary ground has been removed.

III. INSPECTION OF EQUIPMENT ON LIVE LINES

1) Inspection will be carried out from ground level.

2) No man shall climb above the anti-climbing device until under observation by another at ground level.

IV. TESTING OF INSULATORS ON LIVE LINES

1) Special care will be taken at tension, double circuit, transposition and terminal tower, poles in view of close proximity of live crossover connections.

2) Works shall be carried out under "caution Order" as in the case of Hot Line work.

3) Testing shall not be carried out when humidity is above and shall be discontinued if thunderstorm approaches.

4) One man should be stationed on ground to see that the man testing the insulator maintains necessary clearances.

V. LINE WORK ON POLES AND TOWER

1) Before climbing any elevated structure every employee shall first assure himself that the structure is strong enough to sustain his weight safely.

2) If poles or cross arms are apparently unsafe because of decay or unbalanced tension of wires on them, they shall be properly braced or guyed before they are climbed on.

3) Workers shall use Zula, safety rope while working on poles and towers.

4) Safety straps should not be placed above the top cross arm when it is at the top of the pole.

5) No tools above12" (300 mm) in length including length of its handle / grip shall be taken up the tower when both the lines are alive.

6) All light equipment and tools to be used aloft should be raised and lowered by means of hand line and canvas bucket, or other suitable container. Men on the ground should stay clear of overhead work to prevent being struck by falling objects.

7) Tools and materials should not be thrown from the ground to a lineman working aloft, nor should lineman throw tools and materials from above to the ground.

8) Broken insulator or other sharp edged material shall not be left in vacant lots. Along the right of way or in the location where the hazard of cutting feet could be caused to men or animals.

9) When stringing wire across streets and highways avoid interfering traffic or causing injury to workmen or pedestrians. Danger signs should be erected on both sides of the work location and where condition warrants, flagmen should be stationed.

10) Hand lines, materials, tools or equipment must not be scattered around streets, sidewalks, highways etc. but must be kept in a neat orderly manner, where they will not be liable to cause accident.

11) No wire be raised or lowered on the poles/towers where adjacent lines are live.

VI. TREE TRIMMING

1) The public shall be protected against hazards of tree trimming along public streets and highway by placing danger signs and signals.

2) Before climbing a tree, the trimmer should look it over carefully to decide how best to climb to the best location from which to work and the ground area where brush and limbs may be safely dropped.

3) Before climbing, the limbs should be carefully inspected to make sure that they will hold the trimmer's weight. Dead or decayed limbs are not safe to support any weight.

4) Axes shall not be used aloft; always use saws or bill hooks.

5) Avoid dropping tools from aloft to the ground. All tools should be raised and lowered by hand lines in such a way as to avoid touching hot conductors.

6) Part of trees in contact with live wire should be handled as live wires.

7) Before cutting down a tree, all limbs should be cut off for a sufficient height to avoid striking electric lines. Where, there is danger that the tree may strike and damage property, block and tackle should be used to control the direction of fall.

8) Felling operation, once started, should be finished before the crew leaves for the night or lunch hour.

VII. RIGHT OF WAY CLEARING AND TRIMMING

1) Transmission lines right of way that requires trimming and clearing are located mostly in thinly populated districts where the hazard to the public is not usually great. However, a number of hazards shall be guarded against including the following.

a) When walking through slush, use ankle high canvas boots to prevent injury to feet from broken insulators, thorny undergrowth, shells etc.

b) Extreme care should be taken in handling axes, brush hooks and other sharp outing tools.

c) Trees should be carefully felled to prevent their falling on transmission lines or adjacent buildings.

d) Avoid starting grass or forest fires.

VIII. PATROLLING LINES.

1) Emergency line patrol, trouble shooting on transmission lines and similar work should always be done with the greatest caution. Patrolmen should be particularly alert at night to avoid walking into fallen wires or metal fences which may be energized by fallen conductors.

2) Be careful with lighted cigarette and matches which may cause a fire along transmission line right of way. Break matches and crush cigarette stubs into earth on discarding.

3) Patrolmen should be alert for stumbling, hazards, poisonous plants and snakes.

SAFETY RULES FOR HOT LINE MAINTENANCE

General rules and precautions:

1. Nothing in these rules for hotline maintenance shall be constructed as prohibiting any authorized line man from performing routine opening and closing of manually operated hook disconnecers and switches, or replacing of fuses on high voltage lines, provided proper methods are followed and approved tools are used. These operations do not fall within the scope of „hot-line" woks.

2. Hot-line maintenance cannot be always governed by firm and steadfast rules, and the supervisor must exercise a certain amount of ingenuity in following safe methods for accomplishing various jobs. However this provision shall not permit any supervisor to violate any rules contained herein, but shall cover only situations not dealt within these rules. The idea of safety is paramount from the beginning of the job up to its satisfactory and safe completion.

3. Hot-line maintenance should only be done during favourable weather conditions. Rain, snow, sleet, dampness. mist, high-winds, etc. produce condition under which hot-line maintenance shall not be permitted.

4. Only crews selected and specially trained for such work in approved centers shall be employed in hot-line maintenance. The selection of crew shall be based on the following factors:

a) Experience:

b) Training;

c) Temperament and general fitness;

d) Habits and judgments";

e) Mental and physical fitness;

f) Reputation for carefulness; and Alertness.

5. A minimum hot-line maintenance crew shall consist of four experienced linemen (A supervisor and three linemen). The only exception is that a supervisor, two linemen and a ground man may perform work on lines of 15000 Volts or less and on those supports where no lines of higher voltages are present.

6. Only approved hot-line maintenance tools and ropes shall be used and it shall be the duty of sub-Divisional officer in charge of crew to ensure that these are in good condition. This does not relieve the supervisor from his responsibility of inspecting the tools before the work is started.

7. Only one conductor or wire on the same structure shall be worked upon at one time.

8. Wooden structures and steels structures shall be considered alike and the insulating value of wooden poles or structures shall not be depended upon for protection.

Safety rules for Supervisor:

1. The supervisor shall designate the tools to be used and the method to be used for each individual job, adhering to safety rules herein. He shall be held directly responsible for enforcement of all these safety rules.

2. It shall be the duty of the supervisor to see that he has sufficient experienced men, material and tools to do the job safely.

3. While linemen are actually engaged in hot line maintenance work, the supervisor shall give their operations his undivided attention and shall direct their work from a location from where he can be in a position to caution or warn them, if necessary. If it is necessary, for any reason, for the supervisor to leave the job or devote his attention to another matter, he shall not do so until he has notified the linemen working who shall then cease all work until notified by the supervisor that he is back on the job.

4. The supervisor shall not attempt any hot-line maintenance work which, in his opinion, is beyond the ability of the men or the equipment, but shall notify his immediate superior officer that in his opinion the work is unsafe.
5. A complete survey of the job shall be made by the supervisor and a detailed plan to be followed must be decided on before the work is started.
6. It shall be the duty of the supervisor to see that the men doing the work understand thoroughly the procedure to be followed before any work is started.
7. No other work of any nature shall be performed on a pole or structure while hot-line maintenance work is in progress.
8. Before any crew is permitted to work on hot-line maintenance work, they must be trained on de-energized equipment. This preliminary training and the use of hot-line maintenance tools must be very thorough and include every detail of hot-line maintenance work, which the crew is required to perform.
9. Employees shall be cautioned against the danger of coming in contact with any guy wires attached to structure upon which hot-line maintenance is being performed.

Safety rules for linemen:

No line man shall start to do any hot-line maintenance work without first assuring himself that he thoroughly understood the work to be done and the method of doing it. In case there is any doubt in his mind, he shall ask the supervisor and receive the required information from him.

1. The lineman shall at all-time keep parts of his body as far as possible from the tool end of the stick. On poles with vertical formation with or without tapings, where there is an abundance of hardware, rubber gloves should be used while changing out dead-end disc to eliminate the effect of static discharges.
2. Linemen shall see that their safety belts are properly fastened before they start work.
3. When in doubt concerning the strength of the tool or, piece of equipment, it should not be used.
4. Hot-line maintenance tools shall not be carried up poles or towers in safety belts but tool bags or hand lines shall be used for this purpose.
5. The line-men must be certain, before he attempts any work, that his companions on the pole thoroughly understand the work to be done. Conversation should be limited to the necessary remarks concerning the work. No conversation, not pertinent to the work, shall be permitted.
6. The linemen shall not change the position on the structure without informing his fellow linemen as to what he intends to do.
7. Under no circumstances should a lineman depend upon another linemen to hold a live conductor clear of him permanent anchors must be used for this purpose. When blocks are under strain, the ropes must be secured snubbed. It is not permissible to snub to a truck or to a trailer.
8. No knots of lesser security than" two half hitches" shall be used in tying off various lines. Where a line is to be subjected to a strain, a "turn-around" shall be taken around the snub and the completing knot shall be "two half hitches". When joining two lines of the same size temporarily to take strain. a square knot shall be used. If two lines are to be joined permanently, a spliced joint shall be made. When a loop is to be made in the end of the line. a bow line knot shall be used.
9. When removing tie wires, these shall be rolled into a ball or cut short as soon as they are unwound so that under no circumstances will they be long enough to reach a ground or another conductor and to endanger

the lineman. During the installation or the removal of tie wires, a lineman shall steady the conductors on the insulator with a proper tool. Tie wires shall never be used a second time.

10. When moving live conductor, the lineman shall stay below the conductor that is being moved until it is thoroughly secured in a safe working position. Blocks shall be used on the end of the hot-line tools so that the conductor may be moved slowly and carefully.

11. When working on lines paralleling or crossing roads or highways, special attention shall be paid to securing adequate clearance for all moving vehicles.

12. Hot-line tools shall never be placed directly on the ground as it is possible that they might absorb moisture which would reduce their dielectric strength.

13. Linemen must at all-time take extreme care in transporting and using tools so as not to damage them.

14. All tools used on each job shall be carefully inspected before and after the work is done.

15. All tools, when not in use, must be kept in canvas bags or whether-proof boxes provided for that purpose. Care should be exercised to see that tools kept in these bags or boxes are stored in a dry and, if possible warm place. Wooden sticks should be inspected regularly, dried out and thoroughly maintained at intervals, depending upon the extent of use and exposure.

16. Hot-line maintenance work shall not be hurried. The job should be done safely even though it takes more time.

17. The linemen should avoid wearing rings, wrist-watches, identification bracelets, etc. when engaged in hot-line work.

18. Rubber-Gloves should be worn when within reach of the live conductor.

19. Before climbing a pole for carrying out any work, the condition of adjacent poles should be checked and, if required, they should be guyed or reinforced. The adjacent poles should also be checked for loose or broken tie wires, broken insulators, etc.

20. Ground wire should either be covered by rubber goods or lowered down to a safe working distance; it should be ensured that it does not contact with any lines below. Rubber gloves should be worn when disconnecting and connecting ground- wire.

21. Do not throw tools or materials to or from linemen on pole.

22. Ground man must maintain safe working distance from poles.

23. Safety hats should be worn by the entire crew while engaged in hot line work.

24. Suggested working clearances are as follows:-

Line Voltages Min.	Clearances (In Meter)
2,200 to 6,600	0.305
6,600 to 33,000	0.610
33,000 to 66,000	0.914
66,000 to 1, 15,000	1.5214
110,000 to 220,000	
220,000 to 400,000	
400,000 to 800,000	

The working clearance gives the minimum safe working distance from the conductors or from the hot end of Hot-Sticks to the linemen. In General it is a good practice to maintain a working position so that no conductor, regardless of voltage, is within the reaching distance of a lineman.

25. Maintain steady pull on fall lines of hand line or set of blocks; do not jerk.
26. Never tie hand lines, fall lines, snub lines, to truck or other vehicles.
27. Do not use rope directly on conductors carrying over 5000 volts without separating the rope from the conductor by a link stick.
28. Be sure that temporary anchoring devices will handle the strain placed on them.
29. Be sure that temporary lines are tied securely to anchors and that they are placed in such a position that they will not interface with the work in progress. Or be accidently loosened.

CHAPTER – 10

EARTHING

Temporary Earthing

This section covers the detailed procedures for providing temporary earths for the protection of workmen and property while carrying out operation and maintenance works on the already existing lines or construction of new lines for the protection of workmen and property.

Temporary Earths:

Temporary earths are those applied at the actual location of the work, during repair or construction of installations, for the protection of workmen and property.

Following feature of temporary earthing equipment shall be kept in view by persons using it

Earthing devices 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 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 or of equivalent copper section of aluminum cable to an adequate earth clamp or other device for attaching to permanent a connection or to a temporary earthing spike. The earthing should be connected to clean rust free nut bolts of tower/Earthing Electrode

All earthing jumpers shall be of annealed bare and stranded copper equivalent aluminum conductor. Earthing leads for use at substations and lines shall have a cross section of at least 0.645 sq. Cm (0.1 sq. inch) copper equivalents.

Earthing connection shall be continuous.

Least 1.905 cm (3/4") in diameter and 1.524mtrs. / (5ft.) in length. These shall be of conducting earthing rod electrode material and be driven to a depth of at least 0.914 meters (3ft) in a spot considered to give good earth.

Grounding cable/Earth wire used for earthing shall be examined by the employees every time before use.

General precautions to be taken in connection with the application of temporary earths:

1) Before doing any work on deadlines or equipment where there is a possibility of their becoming energized from any source, such line or equipment should be grounded between the location of work and all possible sources of energy.

2) Temporary grounding cables shall be flexible standard copper/aluminum not less than No.1/0 AWG (0.590 inch) and shall be equipped with approved clamps at each end.

3) When grounding lines or equipment the connection to the ground shall be made first and that to the circuit or equipment last. In removing grounds, first remove the connection to the circuit or apparatus and then remove the ground connection. Approved discharge rods should be used in making ground connection to the circuit or apparatus.

4) Where two or more crews are working independently on same line or equipment, each crew shall properly protect themselves by placing their own temporary grounds.

5) No electric apparatus or line shall be earthed until all reasonable precautions have been taken to ensure that it has been disconnected from all sources of supply.

6) The connection for earthing of an apparatus or line shall be applied or removed only by competent persons.

7) When it is necessary to cut a line, bus bar or loop or to repair a broken conductor or damaged loop, 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. The removal shall be carried out in a reverse order to that adopted for the connection of various conductors to earth.

8) All works on dead circuit shall be done between two sets of temporary earths.

9) Earths shall never be attached or removed with bare hands. Rubber gloves, gauntlets or approved protective equipment shall always be used.

10) In so far practicable, the person applying the earths on poles and structures shall maintain his position below the level of conductor to be earthed in order to keep the body away from any that may occur when the earthing device is applied.

11) No temporary earth shall be removed from the equipment while the work is in progress.

12) Employees shall not touch any conductors from which protective earths have been removed.

13) Earthing of one conductor does not render other conductors safe for work. All phases shall be earthed even if work is to be carried out only on one phase.

14) Temporary earth connections should not be connected to neutral wire, guy/stay wire or any other metal part of the structure.

15) The meaning of temporary earth is that it is done for the purpose of carrying out the specific work by creating a safety zone for the protection of working personnel from electric shock.

16) The temporary earthing connection to the lines should be as close to the point of work as possible.

17) High voltage mains shall not be worked upon unless they are discharged to earth after marking them dead and are earthed and short-circuited with earthing and short-circuited with earthing and short-circuiting equipment adequate to carry possible short-circuit currents and which are specially meant for the purpose. All earthing switches wherever installed should be locked up.

18) The earthing device when used shall be first connected to an effective earth. The other end of the device shall then be connected to the conductors to be earthed.

19) Except for the purpose of testing, phasing, etc. the earthing and short-circuit device shall remain connected for the duration of the work.

20) **Removing the 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 earthing device attached to the conductors of the earthed mains 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 earthing device has been removed from it.

21) **Safety precautions of earthing** – The precautions mentioned in (a) to (e) below should be adapted to the extent applicable and possible.

   a) Examine earthing devices periodically and always prior to their use.

   b) Use only earthing switches or any other special apparatus, where provided for earthing.

   c) Verify the circuit is dead by means of discharging rod or potential indicator of approved type. The indicator itself should first be tested on a live circuit before and after the verification.

d) Earthing should be done in such a manner that the person doing the job is protected by earth connections on both sides of the working zone.

e) All the three phases should be effectively earthed and short-circuited even though work may be proceeding on one phase only.

Earthing in Substations:-

Provision of adequate earthing in a sub-station is extremely important for the safety of the operating personnel and for proper system operation. The primary requirements of a good earthing system are as below:

a) The impedance to ground should be as low as possible so as to allow means to dissipate the electric current into the earth without exceeding the operating limits of the equipment. In a large sub-station it should not exceed 1 Ohm and in a small sub-station 5 Ohms.

b) It should provide a safe environment to protect the personnel in the vicinity of grounded facilities from the danger of electric shock under fault conditions.

1) The potentials which determine a safe design include step voltage, touch voltage, mesh voltage and transferred voltage as defined below:

   a) **Step voltage**: -It is the difference in surface potential experienced by a person bridging a distance of one meter between two feet without containing any other grounded objects.

   b) **Touch voltage**: - It is the potential difference between the ground potential rise (GPR) and surface potential at the point where the person is standing while at the same time having a hand in contact with a grounded structure.

   c) **Mesh voltage**: - It is the special case of touch voltage where voltage is transferred into or out of the sub-station.

2) To meet these requirements, normally the earthing system comprising of an earthing mat is buried at a suitable depth below the ground and is provided with ground rods at suitable points. All non-current carrying parts of the equipment in sub-station are connected to this grid so as to ensure that under fault conditions none of these parts are at higher potentials than the grid. Grounding rods perform the function of maintaining low values of resistance under all weather conditions which is particularly important where system earth fault currents are heavy. Under normal condition their contribution is insignificant.

3) In every sub-station, provision for earthing of the following are necessary:

   a) The neutral point of transformers of each separate system should have an independent earth, which in turn should be interconnected with station grounding mat.

   b) Equipment framework and other non-current carrying parts.

   c) All extraneous metallic frameworks not associated with equipment (structures, Sub-stations, gantries, building etc.)

   d) Lightning arrestors should have independent earth. Which should in turn be connected to station ground mat

4) Earthing of sub-station fence is also equally important from viewpoint of touch and step potentials in the area outside the fence.

5) Earthing in the substation must confirm to the requirements of Indian Electricity Rules 1956 and follow the directives laid down in I.S.:3046 of 1966 and its revision.

6) Earthing system has to be designed to have low overall impedance to earth and a current carrying capacity consistent with fault current. The factors which influence the design are:

   a) Magnitude of fault current

   b) Duration of fault current

   c) Ground resistivity

   d) Resistivity of surface material

e) Size and shape of grid
f) Parallel impedance
g) Material of earth electrode

The fault current affects the design in two ways. It determines conductor's dimensions due to its current carrying capacity and it may also influence the mesh width.

As the voltage gradients at ground surface are also dependent on ground resistively, it can also have influence on grid configuration. The overall resistance of grounding grid is also dependent on ground resistivity.

7) In order to economize, currently mild steel (MS) is used in earthmat in our country. To take care of the corrosion etc. some extra margin is provided in the size of earthing strip.

Earthing material & method of reducing earth resistance:

1) Once the layout of Sub-station and earth mat design are finalized, lying of an earth mat is taken up according to the design. 60cm deep trenches are dug for laying the earth strip. The trenches are then filled with low resistivity material i.e. Black Cotton (B.C.) soil free from stone. The filling should be watered and carefully rammed. The main constituents of an earth mat are:
   a) Mild steel Strips (M.S.)
   b) Cast Iron pipes (C.I.)
   c) Sodium chloride (common salt) and charcoal.
   d) RCC rings around cast iron pipes (electrodes)
2) In general, as a standard practice M.S. Strip of 75x10mm or 50x8mm size is used. Sometimes 40mm dia MS rods are also used. The size is decided after considering allowance for corrosion.
3) Cast iron pipe is used as electrode. Its length is normally 3000mm and dia is 150mm. It has got perforations of 16mm in a cross zone manner so as to allow seepage of water to soil around it.
4) The joints of earhmat shall be riveted, brazed, bolted or welded. For rust protection, the welds should be treated with Barium chromate. Welded surface should be painted with red lead and aluminum paint in turn and afterwards coated with Bitumen. Joint in earthing conductor between switchgear units & cable sheath, which may be required to be opened subsequently, should be bolted and joint faces be tinned. All joints in steel earthing system should be made by welding except the points for separating the earth mat for testing purpose which should be bolted. These joints should be accessible and frequently supervised. All exposed steel conductor should be protected with bituminous paint.
5) Switchyard areas are usually covered with about 10mm thick gravel layer or crushed stone which increases safety of personnel. Crushed stone or gravel has high resistivity. By spreading such material in switchyard, high touch potential area are avoided on the surface and thus do not reach equipment, and flashover, short circuit due to reptiles are avoided. This also avoids formation of oil pools in case of leakages from the oil filled equipment. Last but not the least, growth of weeds is controlled in switchyard areas. This entails the provision of service roads for the movement of vehicles etc. required for carrying the equipment from switchyard to service bay. Even through metal spreading is considered the least priority item in earthing system; its serious effect cannot be over looked.
6) Material which are added to the soil to reduce the soil resistivity are as follows:
   a) Sodium chloride (Nacl), coke and sand are the most common, popular and economical materials which are used to bring down the earth resistivity of soil.
   b) Aluminum sulphate is another chemical equivalent to sodium chloride, but it is slightly costlier.

c) Other effective chemicals like magnesium sulphate (mg SO_4, $7H_2O$), calcium chloride ($CaCl_2$) and potassium chloride (KCl) when mixed bring down the resistivity of soil. These chemicals are ten times costlier than aluminum sulphate, and more than ten times costlier then sodium chloride. As such, choice is preferably limited to sodium chloride or aluminum sulphate but mostly the former one.

d) Bentonites clay, which has a property of holding moisture, is another chemical at our disposal, but it is used in high resistivity soil only.

Method of reducing Earth Resistance (ER) of earth electrode & earth mat:

1) Even though the earth mat is designed to the requirement, as the period passes, the earth resistance of electrodes increases due to various reasons. Earth resistance of individual electrodes should be brought down by any method. If additional electrodes of appropriate type are provided and connected to earth mat, the earth mat resistance comes down. In any case, it should positively be below 1.0 Ohm, preferably less than 0.5 Ohm.

Hence, every year, connected & disconnected resistance of each electrode should be measured. If the disconnected resistance exceeds 3 Ohm, it is to be brought down by any of the methods described below. If the earth mar resistance does not come below 0.5 Ohm, additional electrode of appropriate type is to be provided as desired.

2) Method of increasing moisture in the earth pit to reduce resistively:

To keep the E.R. low, watering of earth pit regularly helps to a great extent. Watering shall be done regularly to earth pit in switchyard so that at least 15% moisture exists in earth pit. Weekly watering helps in this regard to a great extent. For this, good water source with water storing arrangement shall be available. Water pipe & tap to each earth pit shall be in working condition. Water pipe line shall not leak; otherwise it will accelerate grass growth in the sub-station.

3) Procedure for immediate/temporary reductions of earth resistance (ER):

Sometimes the E.R. is found to be very high. It then becomes necessary to reduce it immediately. Renovation of the pit may be considered at that time. The procedure is as follows:

a) Remove soil from an area of 300mm diameter (and 300mm depth) surrounding the earthing pipe.
b) Prepare a solution of 20kg of salt in 200 liters of water.
c) Pour this solution in the earth pit with the help of poking rod of iron, by gravity, gradually. This treatment definitely reduces the earth resistance considerably and lasts for a period of one year.

4) Chemical treatment of soil around electrode to reduce E.R.:

1) Chemical treatment of the soil surrounding driven rod is useful for reducing the resistance of a ground where deep grounding is not feasible due to underlying rock. These chemicals are absorbed by the soil and reduce the resistivity in the area.

Magnesium sulphate is least corrosive. Common salt (Sodium chloride) is most economical & gives Magnesium effect in reducing the resistivity of soil. Iron sulphate is poor in this respect. Copper sulphate is better than Iron sulphate. It forms a coating of copper on the electrode, which reduces the corrosion of the pipe. Considering the cost, availability of material and the requirements of effect, suitable chemicals may be used.

This method is a repetitive one. It is to be repeated depending on the porosity of soil and rainfall in the area. Generally it remains effective for 4 to 5 years. Chemical treatment of the soil reduces seasonal variation of resistance of ground resulting from changes in the moisture content of soil in different seasons.

2) In grounding practice, it is always desirable to have a very low value of resistance of ground electrode to ground. In the soils possessing high resistivity, this may be quite difficult to achieve. In such cases, artificial treatment to ground electrodes with some chemicals may be resorted to. Extensive experiments and field trials have been carried out to establish the efficacy of a substance known as "BENTONITE" for this purpose. It is a type of clay loam containing a high percentage of SILICA. Investigation has proved that treatment with Bentonite brings down resistance of ground electrode by 80%. Another interesting feature observed is that there is practically no seasonal variation in the resistance of ground electrode. The efficacy of Betonite lies in the fact that because of its crystalling structure, moisture is retained for a longer period after it is used. Details regarding how to use it are as follows:

5) Method of casting earth electrode by using Bentonite clay:

Where soil strata is hard and needs blasting for excavation, this type of electrode is to be casted.

Method:

a) Excavate a pit of size more than 600mm dia & 500mm deep so that after putting a form box of 600mm dia, persons on opposite side can work.

b) Cut a drum of 200liters in two halves. Prepare slurry of material as mentioned below in the ratio 1:4:0.5 by volume.

- Bentonite clay of specification 8.7 Ohm-meter
- Clean water
- Garden clay

c) Keep erected 150mm/100mm dia C.I. pipe of length 1500mm with the help of horizontal crow-bar tied with pipe by rope at ground level. Pipe shall be located centrally. Before tying the pit to excavation level & arrangement centrally.

d) Sprinkle water inside the form box and give a layer of above mixture of 10 to 15m thickness at the bottom of the form box.

e) With the help of bucket, pour slurry in the form box up to its top around the pipe. To avoid air voids, poking with iron bar shall be done.

f) Fill the black cotton soil around box, in the pit, upto holding ring level of form box.

g) Spray water on the B.C. soil filled in.

h) Lift the form box with holding rings up to B.C. soil level.

i) Repeat above procedure up to a height of 100mm the top of pipe.

j) Leave for curing of earth pit for 3 days.

k) After three days, connect the electrode to earth mat with the help of M.S. strip.

6) Counterpoise method of reducing Earth mat Resistance (ER):

Sometimes due to hard strata in switchyard, it may not be possible to reduce E.R. to permissible value. Under this circumstance, the required number of earth electrodes is to be cast at nearly low resistivity soil or water logging place. Earth mat should then be connected to these electrodes by earth wire with the help of lugs and lead washers. Procedure is as below:

1) Depending on value of E.R. of the earth mat, calculate the number of additional electrodes to be provided by counterpoise method.
2) Prepare (Cast) these electrodes in nearby waterlogged area.

3) The earth wire shall be buried in ground 500 mm deep. There shall be B.C. soil filled around earth wire in the trench excavated for earth wire. If necessary, some salt be mixed in B.C. soil.

This method can give good results. This method is to be adopted where there is *no residential population nearby the route* of counter poise earthing.

7) Method of providing additional electrode in sub-station for reducing earth mat resistance: wherever sufficient space is available and it does not create problem in movements & material handling in the switchyard and soil is of medium resistivity, this method can be applied. It should be ensured that this does not create a jungle of earth pits in the sub-station.

Method:

1) Depending on the existing earth mat resistance, calculate additional electrodes to be provided to bring the earth mat resistance to below 0.5 Ohm in dry season.

2) Additional electrodes may be cast and connected to the earth mat with M.S. strip.

3) It should be seen that the distance between two electrodes is more than seven meters

4) Water taps shall be provided to the additional electrodes. If soil strata are hard, cast additional earth pits by using bentonite clay.

8) Hemisphere method of reducing Earth resistance (ER):

Wherever strata of soil & sufficient working area are available, this method can be used.

1) Depending upon the soil resistivity and existing earth mat resistance, calculate the additional electrodes required by this method.

2) For each electrode-

a) Excavate a hemisphere of radius 3 meters & prepare pit.
b) Erect the earth pipe centrally
c) Prepare a mixture of soft coke powder, salt and sand in required ratio and fill in the form box around pipe.
d) Fill the pit up to holding ring level by B.C. soil around form box.
e) Sprinkle water on B.C. soil & mixture.
f) Lift the form Box with holding ring up to B.C. soil level in the pit & repeat the filling of mixture, B.C. soil & water sprinkling till the whole pit is filled.

Renovation of Earth Electrode:

Whenever the E.R. of earth mat exceeds permissible value, additional earth pits are proposed, but it may create a jungle of earth pits in switchyard. Due to resin, the salt in the mixture in earth pits washes away within a span of 5 years. Under these circumstances it is necessary to renovate the earth pit as per the procedure given below:

a) Disconnect the earth electrode pipe from the entire earth stripe coming to it by providing parallel earth to each earth strip.

b) Remove all the material in the pit.

c) Clean the earth pipe by Acid or any other chemical & soda water to remove the rust on it.

d) Recast the earth electrode with salt, soft coke powder & sand.

e) Clean all the strip ends to remove the rust.

f) Apply cold galvanizing spray to strip contact surfaces of pipe and earthing strip.

g) Connect the earth strips to earth pipe using lead washers. While connecting strip to the pipe, parallel earth should always be available to the strip. Old, rusted nut bolts shall not be used.

Above procedure can give good results. Resistance of earth pit will reduce substantially by this method

CHAPTER – 11

CONSTRUCTION

We should use only good quality and materials as per BIS/ISS specifications, having more than adequate mechanical strength, & the desired factor of safety for the supports and conductors as mentioned in the IE Rules, for construction of transmission lines and substations.

Using these practices would automatically avoid danger to the public and ensure Safety in the Construction.

IE Rule 1956 Sr. No.29 and chapter VIII (Rules Sr. No.74 through 93) give instructions regarding construction of Lines and Sub-station.

General Safety Rules for construction, IE rule 29

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) The material and apparatus used shall conform to the relevant specification of the Bureau of Indian Standards, including National Electrical Code where such specifications have already been laid down.

OVER-HEAD LINES, UNDERGROUND CABLES & SUB STATIONS / IE Rule Provisions.

1. Material and strength, IE Rule No.74

a) All conductors of overhead lines other than those specified in sub-rule (1) of rule 86 shall have a breaking strength of not less than 350Kg.

b) Where the voltage is low and the span is of less than 15 meters and is on the owners or consumer premises, a conductor having an actual breaking strength of not less than 150 Kg. may be used.

2. Joints, IE Rule No.75

a) Joints between conductors of overheads lines shall be mechanically and electrically secured under the condition of operation. The *ultimate strength of the joint shall not be less than 95per cent of that of the conductor*, and the electrical conductivity not less than that of the conductor.

b) No Conductor of an overhead line shall have more than two joints in a span.

3. Maximum stresses, factors of safety IE Rule No.76

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 in accordance with specifications laid down, from time to time, by the Bureau of Indian Standards.

2) Overhead lines not covered in sub-rule (1) shall have the following minimum factors of safety:

i). For metal supports. 1.5
ii). For mechanically processed concrete supports. 2.0
iii). For hand molded concrete supports. 2.5
iv). For wood supports. 3.0

Initial unloaded tension 35 per cent

Final unloaded tension 25 per cent

4. Clearance above ground of the lowest conductor, IE Rule 77

1) For Extra High Voltage lines, 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 meters.

5. Clearance between conductors and trolley wires, IE Rule 78

1) No conductor of an overhead line crossing a tramway or trolley-bus route using trolley wire shall have less than the following clearance above any trolley wire.

   a) Low and medium voltage lines 1.2 meters

      PROVIDED that where an insulated conductor suspended from a bearer wire crosses over a trolley wire, the minimum clearance for such insulated conductor shall be 0.6 metre.

   b) High voltage lines above 11,000 volts 2.5 meters
   c) Extra-high voltage lines 3.0 meters

2) In any case of crossing referred to in sub-rule (1), whoever lays his line later in time,' shall provide the clearance between his own lines and the line which will be crossed in accordance with the provisions of said sub-rule.

   PROVIDED that if the later entrant is the owner of the lower line and is not able to provide adequate clearance, he should bear the cost for modification of the upper line so as to comply with this rule.

6. Clearance from building of high and extra-high voltage lines IE rule 80

1) Where high or extra-high voltage over-head line 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-

   a) For high voltage lines up to and Including 33,000 volts 3.7 meters
   b) For extra-high voltage lines 3.7 meters plus 0.3 meter for every additional 33,000 volts or part thereof.

2) 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-

   a) For high voltage lines up to and Including 11,000 volts 1.2 meters
   b) For high voltage lines above 11,000 volts and up to and including 33,000 volts 2.0 meters
   c) For extra-high voltage lines 2.0 meters plus 0.3 meter for every additional 33,000 volts or part thereof.

7. Conductors of different voltages on same supports

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 linesmen and others from the lower voltage system leakage from or contact with the higher voltage system; and the methods of construction shall be subject to the prior approval of the inspector.

8. Erection of or alteration to buildings, structures, flood banks and elevation of roads.

1) If at any time subsequent to the erection of an over-head line (whether covered with insulating material or bare), 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, he and the contractor whom he employs to carry out the erection, addition or alteration shall, if such work, building, structure, flood bank, road or addition or alteration, thereto would, during or after the construction, result in contravention of any of the provisions of rule 77, 79 or 80 give notice in writing of his intention to the supplier and to the inspector and shall furnish therewith a to scale drawing showing the proposed building, structure, flood bank, road and addition or alteration and scaffolding required during the construction.

2) i) On receipts of the notice revered to in sub rule (1) or otherwise, the supplier shall examine whether the line under reference was lawfully laid and whether the person was liable to pay the cost of alteration and if so, send a notice without undue delay, to such a person together with an estimate of the cost of the expenditure likely to be incurred to so alter the over-head line and require him to deposit, within 30 days of the receipt of the notice with the supplier, the amount of the estimated cost.

ii) If the person referred to in the sub-rule (1) disputes the suppliers estimated cost of the alteration of the overhead line or even the responsibility to pay such cost, the dispute may be referred to the Inspector by either of the parties whereupon the same shall be decided by the Inspector.

3) No work upon such building, structure, flood bank, road and addition and alteration thereto shall be commenced or continued until the Inspector has certified that the provisions of rule 77, 79 and 80 are not likely to be contravened either during or after the aforesaid construction:

PROVIDED that the Inspector may, if he is satisfied that the overhead line has been so guarded as to secure the protection of a person or a party from injury, or risk of injury, permit the work to be executed prior to the alteration of the overhead line, or in case of temporary addition or alteration, without alteration of overhead line.

4) On receipt of the deposit, the supplier shall alter the overhead line within one month of the date of deposit or within such longer period as the inspector may allow and ensure that it shall not contravene the provision of rules 77, 79 and 80 either during or after such construction.

5) In the absence of an agreement to the contrary between the parties concerned, the cost of such alteration of the overhead line laid shall be estimated on the following basis, namely-

   a) The cost of additional material used on the alteration, giving due credit for the depreciated cost of the material which would be available from the existing lines;
   b) The wages of labour employed in effecting the alteration;
   c) Supervision charges to the extent of 15 per cent of the wages mentioned in clause (b); and
   d) Any charges incurred by the supplier in complying with the provision of section 16 of the Act in respect of such alterations.

9. Clearance –General

1) For the purpose of computing the vertical clearance of an over-head line, the maximum sag of any conductor shall be calculated as specified on the basis of the maximum sag in still air and the maximum temperature as specified by the State Government under rule 76(2)(d). Similarly, for the purpose of computing any horizontal clearance of an over-head line, the maximum deflection of

any conductor shall be calculated on the basis of the wind pressure specified by the State Government under rule 72(2) (a)

2) No blasting for any purpose shall be done within 300 meters from the boundary of sub-station or from the High Voltage or Extra High Voltage electric supply lines or tower structure without the consultation 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 Chief Inspector of Mines or the Electrical Inspector of mines.

10. Routes –proximity to aerodromes, IE Rules 84

Over-headlines shall not be erected in the vicinity of aerodromes until the aerodromes authorities have approved in writing the route of the proposed lines.

11. Maximum intervals between supports, IE Rule 85

All conductors shall be attached to supports at intervals not exceeding the safe limits based on the ultimate tensile strength of the conductors and the factor of safety prescribed in **rule 76**.

PROVIDED that in the case of over-headlines carrying low or medium voltage conductors, when erected in, over, along or across any street, the interval shall not, without the consent in writing of the Inspector, **exceed 65** meters.

12. Condition to apply where telecommunication lines and power lines are carried on same supports, IE Rule 86

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 20 kg.

2) 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.

3) Where a telecommunication line is erected on supports carrying a high or extra-high voltage power line, arrangement shall be made to safeguard any person using the telephone against injury resulting from contact, leakage or induction between such power and telecommunication lines.

13. Lines crossing or approaching each other, IE Rule 87

1) Where an over-head line crosses or is in proximity to any telecommunication line, either the owner of the over-head line or the telecommunication line, whoever lays his line later, shall arrange to provide protective devices or guarding arrangement, in a manner laid down in the Code of Practice or the guideline prepared by the **Power and Telecommunication Co-ordination committee (PTCC)** and subject to the provisions of the following sub-rules.

2) 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 to do so along with the relevant details of protection and drawings to the owner of the existing line.

3) 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 their coming into contact with each other

Where an over-head line crosses another over-head line, clearances shall be as under:

Sr. No	Nominal System Voltage	11 – 66kV	110-132kV	220kV	400kV	800kV
1.	Low & Medium	2.44	3.05	4.58	5.49	7.94
2.	11-66kV	2.44	3.05	4.58	5.49	7.94
3.	110-132kV	3.05	3.05	4.58	5.49	7.94
4.	220kV	4.58	4.58	4.58	5.49	7.94
5.	400kV	5.49	5.49	5.49	5.49	7.94
6.	800kV	7.94	7.94	7.94	7.94	7.94

PROVIDED that no guarding are required when an extra-high voltage line crosses over another extra-high voltage, high voltage, medium or low voltage line or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the extra-high voltage line and the topmost conductor of the overhead line crossing underneath the extra-high voltage line and the clearance as stipulated in rule 77 from the topmost surface of the road is maintained.

4) A person erecting or proposing to erect a line which may cross or be in proximity with an existing line, may normally provide guarding arrangements on his own line or require the owner of the other over-head line to provide guarding arrangement as referred to in sub-rule (3)

5) In all cases referred to in the preceding sub-rules, the expenses of providing the guarding arrangements or protective device shall be borne by the person whose line was last erected.

6) 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.

7) The guarding arrangement 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.

8) All works required to be done by or under this rule shall be carried out to the satisfaction of the Inspector.

RIGGING AND HOISTING BY USING CRANES, DERRICK ETC.

1. 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.

2. Before operating a crane, derrick 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 any one.

3. Employees shall familiarize themselves with the proper use of knots, ties and hitches and safe methods of hooking and slinging required in their work.

4. 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.

5. Wire ropes or cable should have clips attached to cables; a sufficient number should be used.

6. When applying U bolt clips to cables, a sufficient number should be used.

7. Following precautions will preserve the strength and life of rope.

   a) Do not use drag rope on the ground unnecessarily as dirt chafes the fibers.
   b) Do not drag ropes on the ground unnecessarily as dirt chafes the fibers.
   c) Do not place kinked rope under stress.
   d) Do not tie knots where splices should be used.
   e) Do not allow ropes to become oil soaked, exposed to acid or corrosive substances.
   f) Do not allow rope to remain exposed to weather any more than necessary. Carefully dry rope when it becomes wet.

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.

   a) Suitable goggles or welding helmets shall be worn for protection while welding. Barriers should be erected to protect other persons from rays of electric arcs or welding flames. Ultraviolet, infra-red and excessively bright visible light rays are injurious to eye.
   b) Clean goggles should be worn while chipping the slag.
   c) Adequate ventilation shall be provided while welding in confined spaces or while brazing cutting or welding zinc, brass, bronze, glavanized or lead coated material, Poisonous fumes may be generated during the welding process by metallic oxides, coatings on the materials bring cut or welded, or by the electrode or flux rod.
   d) While welding or cutting in elevated position, precautions should be taken to prevent sparks or hot metal falling on to people or inflammable materials.
   e) No welding or cutting should be attempted in dusty or gaseous areas where there is a danger of causing explosion.
   f) 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. Avoid personal 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.

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.

EXPLOSIVES: STORAGE AND TRANSPORTATION

1. Detonators for exploding dynamite are of two kinds. Those ignited by fuse known as blasting cap; those fired by electric current are known as electric blasting caps.
2. Only persons who are qualified by training and experience shall be permitted to handle, use or transport explosives.
3. Dynamite and caps shall be stored in separate magazines, 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.)
4. All surpluses explosive shall be returned to magazines as soon as possible following completion of a job.
5. The area within 28th feet (9Mtrs) radius of a magazine shall be kept free of flammable debris and magazines floors shall be kept clear.
6. Smoking and open flames are prohibited within 50 feet (15Mtrs) of any magazine or explosive.
7. Trucks carrying explosives must not be left parked in congested areas, or subjected to major repairs.

HANDLING AND USE OF EXPLOSIVE

1. Smoking and open flames are strictly prohibited within 50 feet of explosives.
2. Explosives, either in containers or otherwise shall not be thrown from trucks, slide along floors or handled roughly in any manner.
3. Do not keep the explosives exposed to direct rays of the sun for a long time.
4. Do not leave dynamite, lighting, explosives, personnel and caps unguarded.
5. During approach and progress of a lightning storm, all handling and use of explosives shall be stopped and all personnel shall seek a place of safety.
6. 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.
7. Deteriorated explosives should be destroyed by methods recommended by the manufacturer. They should not be thrown into streams or bodies of water, nor buried in the ground.

EXCAVATIONS

1. Proper and adequate timber shorting 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. Undercutting 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.

CONCRETING AND CEMENTING

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

EQUIPMENT CONTAINING SUPHUR HEXAFLURIDE (SF6) GAS

1) **Purpose:** - to control inherent dangers involved in Equipment containing SF_6.
2) **Scope:** - This AEGCL safety instruction applies the principle established by the Safety Rules to achieve Safety from the System for personnel working on equipment which contains or has contained Sulphur Hexafluoride gas.
3) **Definition:** - Terms printed in Bold type are defined safety Rule terms, those printed in italic are specified definitions which only apply to this safety instructions.

Gas / zones – Discrete pieces of Equipment which may be independently Isolated and drained of SF_6. A Gas Zone may comprise:-

- A single-phase enclosure
- A single enclosure containing the three phases of an item of Equipment
- Three single-phase enclosures of a common item of Equipment connected by inter-phase pipe work.

4) Equipment identification:-

4.1. Equipment on which work is to be carried out must be readily identifiable. Where necessary, a means of identification must be fixed to it that will remain effective throughout the course of the work.

4.2. Gas zones must be identified as per the layout of equipment.

4.3. Cover plates giving access to portable maintenance earthing positions must be identified. Each position must also be uniquely identified on the enclosure adjacent to its access cover.

5) Dangers:-

The main Dangers to personal from equipment containing SF_6 Gas are:-

- Asphyxiation or suffocation
- Electric shock
- Burns
- The release of soared mechanical energy or pressure.
- Toxic break down products which can be formed with-in the Equipment.
- Damage to ozone layer

6) Preparation for work

6.1. **Gas Pressure:** - Where the integrity of an EHV/HV Point of Isolation is dependent on the presence of SF6 gas, the gas density must be monitored through the period of work. This function may be performed by an automatic alarm system. Care must be taken that if such a system is used it is in service and that it has been regularly tested to prove its operation at low density

immediately prior to establishment of an EHV/HV Point of Isolation. Any loss of gas density must be reported immediately to the Maintenance Engineer/Testing Engineer and Shift In-charge.

6.2. Demarcation of work area

The boundaries of the Equipment on which it is safe to work must be clearly identified.

6.3. **When depressurization is required**:- When depressurization is required, the following precautions must be taken to achieve Safety from the System.

a) The equipment must be drained of SF_6. This must be carried out in accordance with the approved Procedure relating to Sulphur Hexafluoride gas.

b) A point of Access notice must be displayed at each initial entry point. These notices must be fixed or moved by maintenance personnel under the Supervision of Maintenance / Testing engineer.

c) A Permit Work or Sanction for Test must be issued for the work to proceed and where appropriate, the recommendations for General Safety Report must specify the further precautions to be taken to deal with any arc products which may be present. The removal and disposal of any product must be in accordance with the Approved Procedure relating to Sulphur Hexafluoride gas.

CHAPTER - 12

TRANSPORTATION

General Precautions

1. Equipment should be kept in good operating condition and the vehicle should be driven in a safe manner so as to prevent injury to the employees and others.
2. Employees shall not operate a car or truck, unless he has the proper license in his possession.
3. Every driver of the car 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 DTO Passing is done for the vehicle.
5. Labor carrier certificate (5 yearly) approved by DTO should be available.
6. Test the brakes, clutch, horn and lights.
7. See that tyres are in good condition and properly inflated.
8. Check emergency equipments such as first aid kits, jacks and tools. Any equipment found missing or defective should be reported immediately.
9. Every driver shall report the vehicle's defect it any is detected.
10. Before filling the fuel tank, the motor should always be shut off. The hose nozzle should be kept in contract with the tank to avoid static sparks. While filling the petrol tank, smoking or using an open flame near the vehicle should be avoided.

DRIVING

1. Most traffic accident can be prevented by faithful observation of three things.
   a) Control speeds', speeding is dangerous. A few minutes saved at the cost of an accident is no bargain.
   b) Avoid distractions. Give your undivided attention to the job of driving. Keep your eyes on the road.
   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. Keep safe distance from the vehicle in front.
3. 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.
4. 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.
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 persons and objects are out of the way.

OPERATION OF TRUCKS AND TRAILERS.

1. Before starting a truck, the man in charge of the party 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 should not be permitted to be extended beyond the sides unless the necessary permit has been obtained from the Authorities.
3. The 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 Endeavour to get all facts in the case. Remember that accidents which may appear trivial often result in claims for personnel 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- Pull over 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) Assist injured persons in so far as you are able, giving immediate attention to severe bleeding. Do not move seriously injured persons unless necessary for their protection against further injury. Send for doctor and ambulance, if necessary.
   c) When requested, give your name, address company affiliation and show driver's license to the other party.
   d) Secure name, address and license number of the other driver, car licence number and names and addresses of car owner and insurance company.
   e) Record names and address of witnesses.
   f) Unless some policeman is present at the scene of the accident, notify police having jurisdiction in the territory.
   g) 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.
   h) Notify your supervisor, and also submit written report with all useful information which you possess.

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 rules 79 and 80, unless such materials are transported under the direct supervision of a competent person authorized in this behalf by the owner of such over-head conductors or lines.

2. Under no circumstances rods, pipes or other similar materials shall be brought within the flash over distance if bare live conductors or lines; and

CHAPTER - 13

Safety Aspects during Civil Works:

1. In exercise of the Power Conferred by clause (a) of sub-section 2 of section 176 of I.E. Act. 2003. An Electricity plan prepared under the provision sub-section 4 of section 3 of the Act shall be published in the Govt. gazette and at least two daily vernacular Language Newspapers.
2. The plan layout of the sub-station for method of Construction & Route of line must be got approved from Electrical inspector.
3. After approval of Electrical plan layout of switchyard, a civil foundation plan layout is to be prepared & got approved from competent authority then only the Civil Work is taken in hand.
4. **Site selection in view of safety**
   a) Connectivity & approach to the highway is important so that fire brigade & ambulance can reach the sub-station immediately in case of accident & fire.
   b) For safe & easy transportation of material to sub-station in all seasons it is important to have proper road connectivity & approach.
5. **Land Leveling:-**
   a) The leveling of the land is done to make available a plain land for switchyard development.
   b) There shall not be water logging during the rainy season/rain water must drain away.
   c) The level of the cable trench should be maintained so that water will be drained away immediately.
6. Construction quality has long term effect on safety, hence ensure excellent quality of work during every stage of the project construction.
7. The Record of the Civil Quality test taken at all stages of construction must be documented / preserved.
8. Seasonal & Trained young personnel must be engaged for civil work, preferably with knowledge of the site.
9. Personal Protective Equipments (PPE) like Helmet, safety belt, boots hand lamps etc. must invariably be used & while working in the yard like Helmet, safety belt, boots hand lamps etc.
10. **IE Rule 51**: Inspector should see that clear space of 90cm is provided in front of the main panel and space behind switch board should be either exceeds 75cm or less than 20cm.
11. **IE Rule 64**: Trenches in the sub-station containing cable shall be filled with non-inflammable Material & shall have slabs cover.
12. **IE Rule 68(b)**, Outdoor sub-station shall be provided with a fencing not less than **11 feet** in height.
13. **IE Rules 29** The space of the outdoor sub-station shall be spread with stone metal. Growth of Bushes/Trees in this area shall not be allowed.
14. **IE Rules64**, if transformers are having more than 2000 litres of oil, a baffle wall with a fire rating of four hours shall be provided between them.
15. **IE Rule 29** Rubber matting shall be provided in front of Switchgears/Panels.
16. **Child Labor** – It is criminal to employ child labor.

Unsafe Conditions in Civil Work

Sr. No	Unsafe Conditions	Prevention
1.	Risk of fall of worker during installation due to a) Open pit of Civil foundation b) Open Cable Trench c) Unguarded opening from First / Second floor in slabs.	a) The foundation pit must be barricaded by the Rope & danger signs b) Put Cable Trench covers. c) Put barricade around the opening and place danger/warning signs as necessary
2.	Mistake in Civil Layout a) Insufficient clearances b) Insufficient clearances for movement	The Plan of the layout must be got approved from competent authority and take necessary corrective steps during construction in consultation with competent authority.
3.	Uneven foundation a) Inclined superstructure b) Inclined equipment	The level of the foundation must be maintained & level to be taken by dumpy level must be taken before casting the foundation
4.	Accident during transportation/material handling a) Road not Ready b) Inadequate strength width / Curvature	Good quality internal Road must be ready with adequate width & curvature before actual transportation of material is started.
5.	Uneven Roof level	Arrangement must be made to drain out the rainy water so that the water leakage eliminated
6.	Snakes in the cable trench	Use poisonous gas sprays at regular interval.
7.	Inadequate water arrangement & its storage.	Before start of work the water arrangement must be made for a) Drinking b) Civil work For the initial stage of civil work, Temporary water arrangement must be done for drinking & other works.
8.	Open water pipe line	The pipe line must be layed under ground
9.	Roof leakage During rains and water spray through window.	Water proofing of Roof-top parapet wall above window should be done.

Unsafe Act

Sr. No	Unsafe Act	Prevention
1.	Digging in the switch yard without knowledge of underground wiring/cable/ water pipe line.	Work must be taken under the supervision of authorized person with adequate knowledge of the site.
2.	Putting lot of debris & garbage in the yard	Put the yard clean, keep out unwanted equipment/material outside the yard as soon as the work is over.
3.	Large heap of soil from excavation	Put danger signs and ,barrier fencing round the uncompleted work
4.	Running around in the yard with Rush of work	Plan the work & be calm on the worksite.
5.	Survey in the substation by Iron Ranging Rod	Use Bamboo in Place of Iron Rod

Identification of the name of equipment & Demarcation of work hazardous/dangerous Area in view of Safety.

IR Rule 35 (Danger) notice:-

The owner of every medium, high & extra high voltage installation shall affix permanently in a conspicuous position a (Danger) notice in Hindi or English & local language of the district, with a sign of skull & bones (of a design as per relevant **ISS no.2551**) –

If the Danger Board affixing is not possible the word 'Danger' & the voltage of the apparatus concerned shall be permanently painted on it.

PROVIDED that where it is not possible to affix such notices on any generator, motor, transformer, or other apparatus, they shall be affixed as near as possible thereto or the word "danger" and the voltage of the apparatus concerned shall be permanently painted on it;

IE Rule 41: Distinction of different circuits

The owner of every sub-station, junction-box or pillar in which there are many circuits or apparatus, (whether intended for operation at different voltages or at the same voltage), shall ensure by means of indication of a permanent nature, that the respective circuits are readily distinguishable from one another.

IE Rule 41A: Distinction of the installations having more than one feed

The owner of every installation, including sub-station, double pole structure, four pole structure or any other structure having more than one feed, shall ensure by means of indication of a permanent nature, that the installation is readily distinguishable from other installations.

IR Rule 91 – Safety and Protective devices:-

1) Every overhead line (not being covered with insulating material) erected over any part of street or other public place or in factory or mine or on any consumer premises shall be provided with a device approved by the inspector for rendering the line electrically harmless in case it breaks.

2) Anti-climbing devices:-

The owner of every HV/EHV O/H line shall make adequate arrangements to the satisfaction of inspector to prevent unauthorized persons from ascending any pole of such line, which can be easily climbed upon without the help of a ladder or special appliances.

To comply this rule, provide either steel spikes in all the directions on the pole or provide barbed – wire (with clamps) between **7 ft. and 11ft**. On the pole to accommodate **48 turns of barbed-wire**.

Identification:

It will be easy to identify when the Location line when

1) The Each Tower of the line with Location Number.
2) Each Equipment is marked with code Number & bay Name.
3) For easy identification Each Room is marked with Room name plate in the building

Affix permanently, with Bold Letters, on visible Position-.

1) Identification labels on the line
   a) Tower Location Number Plate
   b) Phase plate (Indication R-Y-B Phase)
   c) Circuit Name plate in case of Double Circuit line

d) Anti climbing device with Danger Notice.

Indicating plate cum Notice Board must be fixed on the Tower Line which will help in avoiding accident and lead to safety.

2) Sub-station switch yard

a) Each bay in the switch yard shall be painted permanently with bay name (like 220kV Samaguri line-I bay)

b) Each equipment/control box shall be painted with their code name like.

I) Breaker – 52

II) Isolator (Line side) 29(D) PT Isolator

Auxiliary 29 (C)

Main bus-I 29 (A)

Main bus-II 29 (B)

III) C.T/PT/LA/CC/with colour code (R,Y,B)

IV) Control Box

a) Isolator Control Box

b) CT/PT Control Box

3) Building:-

a) Control Room –Name of bay on control & relay panel. All Control & Relay Panel must be painted with respective Name of bay

b) Battery Room.

c) Battery Charger Room.

d) PLCC Room

e) AC supply Room (Name of the feeders)

f) Air conditioning plant Room

g) Office of the Incharge

h) Store Room

i) Laboratory

By painting the Name on the equipment/Room

1) It will be easy for identification of equipment on which work has to be carried out.

2) Demarcation of working Area is easy.

3) Identification of work spot from long distance is easy visible.

Demarcation:-

Before any work is to be started / carried out in or adjacent to a charged (live) area the work area to be clearly demarcated.

1. WARNING BOARDS

Warning boards shall be placed by the person-in-charge, on all switchgear before men are permitted to work and should only be removed by the person who has placed them. It is desirable that the person issuing the permit shall place one warning board on the switch energizing the mains for each permit issued so that he can be sure that all the permits-to-work are returned when he has to charge the mains.

2. VISITORS AND UNAUTHORIZED PERSONS

Visitors and unauthorized persons shall not be allowed to proceed to the vicinity of live mains and apparatus, unless accompanied by an authorized person who will be responsible to ensure that his instructions regarding safety are strictly complied with.

3. WARNINIG THE PUBLIC

a) When, either accidentally or otherwise, live mains and apparatus pose a danger to persons in a public place, a person shall be directed to stand at such locations for personally warning the public until the danger has been removed/cleared.

b) Equipment on which work is to be carried out must be readily identifiable. Where necessary a means of identification must be fixed to it, which shall remain effective throughout the course of the work.

4. DANGERS

The main **Danger** to personnel working in substation.

- The possibility of **mistaking Equipment** on which it is unsafe to work.
- Inadvertently infringing **Safety Clearances**.
- Other induced voltage on the **Equipment from adjacent/nearby live equipment/line**.
- Failure to make proper use of personal protective equipments.

5. Where work is to be carried out near to **Equipment** which may be **Live**, then the limits of the work area must be defined as per the **Safety Clearance**.

6. Boundary mark must be clearly identifiable and easy to see. They must only be fixed or removed only by the maintenance personnel under the **Supervision** of the Maintenance **Engineer / Shift Engineer**.

7. **Boundary marking should**

a) Be independently supported.
b) Not be attached to any structure supporting any Equipment.
c) Not carry any notice.
1) The boundary of the work area must be identified using plastic tape or nylon rope of about 8 / 10 mm diameter.
2) Where the work is separated from adjoining areas by fixed screens, the work must be identified by green cones placed within the safe area and visible from the outside at each point of access. The fixed screens must remain in position during the course of the work.

CHAPTER – 14

TREATMENT FOR ELECTRICAL SHOCK AND BURNS

TREATMENT FOR ELECTRIC SHOCK

IT MUST BE REMEMBERED.

1) ACT AT ONCE, DELAY IS FATAL

2) DEATH FROM ELECTRIC SHOCK IS RARELY INSTANTANEOUS.

3) HEART FIBRILLATIONS (HEART MUSCLE TREMORS) PERSIST AS LONG AS 30 MINUTES AFTER AN ELECTRIC SHOCK, THEREFORE LIFE CAN BE SAVED BY IMMEDIATE ARTIFICIAL RESPIRATION.

4) SEND FOR BUT NEVER WAIT FOR A DOCTOR FOR FIRST AID / ARTIFICIAL RESPIRATION.

5) CONTINUE ARTIFICIAL RESPIRATION FOR FOUR HOURS AFTER APPARENT DEATH OR TILL THE DOCTOR ARRIVES.

1) General

a) In most cases of electric shock and collapse, it is the lungs and the diaphragm that are most affected and there is a very good chance of revival by applying quickly artificial respiration. Methods of artificial respiration generally used are described in (4) and all persons concerned should qualify themselves by practical study and drill in the treatment for electric shock according to these methods.

b) While rendering artificial resuscitation, violent operations should be avoided as injury of the internal organs may result from excessive and sudden pressures.

c) In case of severe shock respiration is seldom established under an hour while 3 to 4 hours or more might be found necessary to restore normal breathing. It is, therefore, essential that in all cases of electric shock, where the condition of the patient is doubtful or the patient is unconscious or not breathing, artificial resuscitation should be continued until death is diagnosed by a physician or until rigor mortis sets in.

2) Removal from contact

a) If the person is still in contact with the apparatus that has given him shock, switch off the electric circuit at once. If it is not possible to switch off the circuit quickly, no time should be lost in removing the victim from contact with the live conductor.

b) The victim's body should not be touched with bare hands; instead rubber gloves should be worn. However, if the rubber gloves are not available the victim should be pulled off from the live conductor by dry newspaper folded into 3 or more thicknesses. Wooden bamboo or broom handle may also be used to raise the body or to detach it from live conductor. A good plan is to stand on dry board or stool or on few layers of thick newspaper bundles or even dry sacking and remove the victim from the live conductor.

c) Preliminary Steps- If the patient's clothes are smoldering, the sparks should first be extinguished. The doctor should be immediately sent for and, in case the breathing has stopped, immediate action as given in 3.4 should be taken.

3) Immediate Action to Recover Patient

3.1. When a man has received a severe electric shock, his breathing usually stops. In accidents of this kind, speed may save the injured man's life. Hence, no time should be wasted in sending for a doctor, but the patient should not be neglected during this period.

3.2. The patient should not be placed in such a position which may bring pressure on the burns he may have sustained. He should also not be exposed to cold. Stimulants should not be administered unless recommended by a doctor. Cold water may be given in small quantities in case of electric fire or asphyxia and smelling salts may also be administered in moderation.

3.3. Artificial respiration, without interruption, until natural breathing is restored, should be continued. Cases are on record of success after about 3 to 4 hours effort and even more.

3.4. Resuscitation should be carried on at the nearest possible place of accident. The patient should not be removed from this place until he is found breathing normally, and then also moved only in a lying position. Should it be necessary due to extreme weather conditions or other reasons to remove the patient before he is breathing normally, he should be kept in a prone position, and placed on a hard surface or on the floor of a conveyance, resuscitation being carried on during the time that he is being moved.

3.5. A brief return of spontaneous respiration is not a certain indication for terminating the treatment. Not infrequently, the patient, after a temporary recovery of respiration, stops breathing again. The patient should be watched, and if normal breathing stops, artificial respiration should be resumed at once.

3.6. Upon Recovery – when the patient recovers, he should be kept lying down and not allowed to get up or be raised under any circumstances without the advice of a doctor. If the doctor has not arrived by the time the patient has revived, he should be given some stimulant, such as a teaspoonful of aromatic spirits of ammonia in a small glass of water, or a drink of hot ginger, tea or coffee. The patient should then have any other injuries attended to and be kept warn, being placed in the most comfortable position.

3.7. First aid treatment should be given to all the burns.

4) ARTIFICIAL RESPIRATION

4.1. General

4.1.1. The various methods of artificial respiration usually adopted are described below for general information only, and are not meant to replace the method actually followed in the area concerned in accordance with rule 44 of the Indian Electricity Rules, 1956.

4.1.2. Schafer's method is the most common method used for artificial respiration. In recent years, many countries have changed over to more efficient ones, through Schafer's method has the merit of being the least exhausting to perform and not requiring the use of any apparatus or appliances.

4.1.3. The first action the rescuer should take as he reaches near the victim is to disengage him (the victim) from the live circuit. The instructions given in different methods of artificial respiration should be followed, even if the patient appears dead. As soon as possible, feel with your fingers in the patient's mouth and throat and remove any foreign body (tobacco, artificial teeth, etc.). If the mouth is tight shut, pay patients clothing but immediately begin actual resuscitation. Every moment of delay is serious.

4.1.4. All concerned should be advised to study and practice under proper guidance as many methods of artificial respiration as possible.

4.2. Schafer's Prone Pressure Method

4.2.1. Lay the patient on his belly, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on the second hand or forearm, so that the nose and mouth are free for breathing.

4.2.2. Kneel, straddling the patient's things, with your knees overheads at such a distance from the hip bones as will allow you to assume position with shown in fig.1. place the palms of the hands on the small of the back with fingers resting on the ribs, little finger just touching the lowest rib, with the thumb and fingers in a natures position, and the tips of fingers just out of sight.

4.2.3. With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. Do not bend your elbows. This operation should take about two seconds.

Now immediately swing backward so as to completely remove the pressure.

After 2 seconds, swing forward again, thus repeat deliberately 12 to 15 times a minute the double movement of compression and relaxation, a complete respiration in 4 or 5 seconds.

4.2.4. As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest or waist. Keep the patient warm. Do not give any liquids whatever, by mouth until the patient is fully conscious.

4.2.5. To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, he should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a hot drink of coffee or tea, etc. The patient should be kept warm.

4.2.6. A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently, the patient, after a temporary recovery of respiration stops breathing again. The patient should be watched and, if natural breathing stops, artificial breathing should be resumed at once

4.2.7. In carrying out resuscitation, it may be necessary to change the operator. This change should be made without losing the rhythm of respiration. By this procedure, no confusion results at the time of change of operator and a regular rhythm is kept up.

4.2.8. **Silvestre's Method** (Arm-lift Chest-Pressure Method)- this method is illustrated in **Fig.2.** The patient is laid on his back. His arms are grasped above the wrists and drawn first upward and then above the head until they touch the floor. Then they are brought back to the chest and pressure is exerted in a downward direction. The main defect of this method is that the tongue which is a boneless mass of muscle, having lost its tone due to lack of respiration, tends to fall back and block the wind pipe in about 50 percent of the cases, causing a choke. So, a second operator has to pull out the tongue and hold it so. But, sometimes no second man may be available. If, however, a large thick pad is placed behind the shoulders, so that the head lies dangling download, the tongue does not seem to obstruct.

4.3. **Eve's Rocking Method** – This method is illustrated in fig.3. in this method the patient is placed prone on a stretcher and his hands tied to its frame. He is then rocked by titling the stretchers. If stretchers are unlikely to be available readily. It may, however, be possible to use a light two-wheeled hand-cart for the purpose and the method is worth trying. In the case of children this method is very easy to apply. The operator stands holding the child in his hands and rocks in this manner. It has been

claimed that the rocking which is peculiar to this method induces greater circulation of blood in the body and brain, helping earlier recovery.

4.4. Hip-Lift Back-Pressure Method

4.4.1. Though this method has the drawback that it is the most exhausting to the operator and difficult to apply if the victim is heavy, it is useful when the victim has been injured in the upper part of the body-chest, neck, shoulders or arms, or where due to lack of space, it is difficult to use the arm-lift back-pressure method.

4.4.2. Place the victim prone with his face on one side and resting on the back of one hand which is bent at the elbow. The other arm is extended so that the hand is above the head. Straddle the victim at the level of his hips, kneel on one of your knees and put your other foot on the ground near his hip opposite the kneeling knee.

4.4.3. Place your hand on the middle of his back just between the shoulder blades with your fingers spread downwards and outwards and thumbs nearly touching. Now rock forward and allow the weight of your body to exert slow, even pressure downwards till resistance is met.

4.4.4. Release the pressure quickly, remove your hands from the victim's back, rock backwards and slip your fingers underneath the hip bones (not waist). Lift his hips 10 to 15 cm, keeping your arms straight and not bending your elbow to facilitate lifting. This lifting causes air to be sucked into the lungs.

4.4.5. Lower the victim's hips thus completing the full cycle. There should be about 12 cycles per minute. If a second man is available, he can relieve the first operator after one of the lift phases.

4.5. Arm-Lift Back Pressure Method.

4.5.1. This is called **Nielson's Method** in Denmark and has been modified by professor Drinker of USA. The modified method is illustrated in **fig.4.** The subject lies prone with both arms folded and hands resting, one on the other, under his head. The arms are grasped above the elbow and lifted until firm resistance is met. This induces active inspiration. Then they are let down and pressure applied on the back to cause active expiration.

4.5.1.1. The movement in this method follow the sequence given below:

i. **Position 1** – Place the victim prone (that is, face down) with his arms folded with one palm on the other and head resting on his cheek over the palms. Kneel on one or both knee at victim's head. Place your hands on the victim's back beyond the line of armpits, with your fingers spread outwards and downwards, the thumbs just touching each other.

ii. **Position 2** – Then gently rock forward keeping arms straight until they are nearly vertical thus steadily pressing the victim's back. This completes expiration.

iii. **Position 3** – Synchronizing the above movement, rock back-wards, releasing pressure and slide your hands downward along the victim's arms and grasp his upper arm just above the elbows. Continue to rock backwards.

iv. **Position 4** – As you rock back, gently raise and pull the victim's arms towards you, until you feel tension in his shoulders. This expands his chest and results in respiration. To complete the cycle, lower the victim's arms and move your hands up for initial position.

v. This method is considered to be the best, being most effective, easy to teach and fairly easy to perform.

4.6. **Pole-Top Method** – when a person receives electric shock it is most important that the artificial respiration is started without any loss of time whatsoever. Indeed, the non-neglect of the first few minutes is so necessary that in the USA, where a good deal of live line work is done, a method of

artificial respiration, called the Pole-Top Method, has been developed. The victim of the shock will be hanging by his safety belt and the rescuer ascends the pole, supports the victim astride his own safety belt, and rhythmically compresses the victim's abdomen with both hands while he is being lowered to the ground. He is then changed on to one of the more effective methods. Several cases of successful operation of this method have been reported. The need for not wasting any time whatsoever in starting artificial respiration cannot, therefore, be overemphasized.

4.7. Mouth-to-Mouth Method

4.7.1. Place victim on his back. Place his head slightly downhill, if possible. A folded coat or similar object under victim's shoulders will help maintain proper position. Tilt head back, so that the chin points straight upwards.

4.7.2. Grasp victim's jaw as illustrated in fig. 5 (Position 1) and raise it upward until lower teeth are higher than upper teeth; or place fingers on both sides of jaw near lobes and pull upward. Maintain jaw position throughout resuscitation period to prevent tongue from blocking air passage.

4.7.3. Tack a deep breath and place your mouth over victim's mouth making air-tight contact. Pinch the victim's nose, shut with thumb and forefinger or close nostrils by pressing your cheek against them. If you hesitate at direct contact, place a porous cloth between you and victim. If an infant, place your mouth over its mouth and nose.

4.7.4. Blow into victim's mouth (gently, if an infant) until his chest rises. Remove your mouth to let his exhale, turning your head to hear outrush of air. The first 8 to 10 breaths should be as rapid as victim will respond, thereafter rate should be slowed to about 12 times a minutes (20 times if an infant).

4.8. Things to Remember

a) If air cannot be blown in, check position of victim's head and jaw and recheck mouth for obstruction then try again more forcefully. If chest still does not rise, turn victim's face down and strike his back sharply to dislodge obstructions.

b) Sometimes air enters victim's stomach, evidenced by swelling of stomach; expel air by gently pressing down on stomach during exhalation period.

4.9. **Duration of Movements**- In all the methods, the rate of a complete respiration cycle is 12 to 15 per minute. When the victim begins to breathe of his own accord the operation should be synchronized with the natural breathing and continued until he breathes strongly.

4.4.4.1. **Advisability of learning Alternative Methods** – It is advisable that all concerned know how to apply more than one good method, since, when there are injuries due to fall or burn, certain methods may not become suitable for application. Next to the Arm-Lift Back-Pressure Method, the Hip-Lift Back-Pressure Method is the best and may be adopted. The Rocking Method may also be learnt and used in special cases.

4.4.4.2. Mechanical Means of Artificial Respiration

CHAPTER – 14.1

BURNS

Joule Burns: The passage of an electric current along any conductor is accompanied by the dissipation of heat. According to Joule's law the heat dissipated is directly proportional to C^2 RT where C is the current in amperes, R is the resistance in ohms and T is the time in seconds. As the skin is the site of the highest resistance in the body it is here that burning is most likely to occur when contact is made with live conductor. Such burns may be deeper than may first appear on clinical examination. Heating is often slow and may be accompanied by much scarring.

Flashover Burns: If an earthed conductor is brought close to another conductor at a high voltage, the insulation of the air between them (dielectric) may break down giving rise to a spark. This ionizes the air considerably lowering the resistance, which in turn allows the current to increase. An electric are is set up between the conductors. If a human being is too close to a high voltage line, he or she will be burnt by the arc without actually coming in contact with the conductor.

Because of the reduced electrical resistance of the air and the large area of the skin burning (which reduces the skin resistance) large currents may flow. The victim therefore becomes subject to a double event, a flame burn from the area and an electric shock from the current, which passes. The burns are often made worse by the clothes catching fire.

Because flash burn accidents are usually associated with high voltages, the current, which flows, are often too great to cause ventricular fibrillation. Also, because the victim does not usually touch the conductor he is practically never "held on" but fall away from the conductor, thus extinguishing the arc. The current therefore usually passes through the victim only for a brief time.

Burns arising from high-voltage electric shock are associated with many complications, only some of which are predictable. Accordingly, accident victims must be cared for by knowledgeable specialists. Heat release occurs primarily in the muscles and neurovascular bundles. Plasma leakage following tissue damage causes shock, in some cases rapid and instant. For a given surface area, electro thermic burns - burns caused by an electric current – are always more severe than other types of burn. Electro thermic burns are both external and internal and, although this may not be initially apparent, can induce vascular damage with serious secondary effects. These include internal stenos and thrombi, which, by virtue of the necrosis they induce, often necessitate amputation.

Tissue destruction is also responsible for the release of chromo-proteins such as myoglobin. Such release is also observed in victims of crush injuries, although the extent of release is remarkable in victims of high-voltage burns. Myoglobin precipitation in renal tubules, secondary to acidosis brought on by anoxia hyperkalemia is thought to be the cause of anoxia. This theory, experimentally confirmed but not universally accepted, is the basis for recommendation for immediate alkalization therapy. Intravenous alkalization, which also corrects hypovolemia and acidosis secondary to cell death, is the recommended practice.

Accidents involving high voltage result in significant burns as well as the effects described for low voltage accidents. The conversion of electrical energy to heat occurs both internally and externally. These can be classified into four groups.

- Arc burns, usually involving exposed skin and complicated in some cases by burns from burning clothing.
- Multiple, extensive and deep electro thermic burns, caused by high – voltage contacts.

- Classical burns, caused by burning clothing and the projection of burning matter, and
- Mixed burns, caused by arcing, burning and current flow.

Follow-up and complementary examinations are performed as required, depending on the particulars of the accident. The strategy used to establish a prognosis or for medico-legal purposes is of course determined by the nature of observed or expected complication. In high-voltage electrification and lightning strikes, enzymologist and the analysis of chromo proteins and blood clotting parameters are obligatory.

The course of recovery from electrical trauma may well be compromised by early or late complications, especially those involving the cardiovascular, nervous, and renal system. These complications in their own right are sufficient reasons to hospitalize victims of high voltage electrification. Some complications may leave functional or cosmetic squeal.

If the current path is such that significant current reaches the heart, cardities vascular complications will be present. The most frequently observed and most benign of these are functional disorders, in the presence or absence of clinical correlates. Arrhythmias-sinus tachycardia, extra systole, flutter, and a trial fibrillation (in that order) are the most electrocardiographic abnormalities, and may leave permanent squeal. Conduction disorders are rare, and are difficult to relate to electrical accidents in the absence of a previous electrocardiogram.

More serious disorders such as cardiac failure, valve injury and myocardial burns have also been reported, but are rare, even in victims of high-voltage accidents. Clear – cut cases of angina and even infarction have also been reported.

Peripheral vascular injury may be observed in the week following high – voltage electrification. Several pathogenic mechanisms have been proposed. Arterial spasm, the action of electrical current on the media and muscular layers of the vessels and modification of the blood clotting parameters.

A wide variety of neurological complications is possible. The earliest to appear is stroke, regardless of whether the victim initially experienced loss of consciousness. The physiopathology of these complications involves cranial trauma (Whose presence should be ascertained), the direct effect of current on the head, or the modification of cerebral blood flow and the induction of a delayed cerebral oedema. In addition, medullar and secondary peripheral complications may be caused by trauma or the direct action of electric current.

Sensory disorders involve the eye and the audiovestibualar or cochlear systems. It is important to examine the cornea, crystalline lens and funds of the eye as soon as possible, and to follow up victims of arcing and direct head contact for delayed effects. Cataracts disorders and hearing loss are primarily due to blast effects of several months. Vestibular disorders and hearing loss are primarily due to blast effects and, in victims of lightning strike transmitted over telephone lines, to electrical trauma.

Early and careful rehydration and intravenous alkalization is the treatment of choice of serious burns.

CHAPTER – 15

FIRST AID

13.1 PREAMBLE

FIRST AID is the immediate and temporary care, given to the victim of an accident or sudden illness. The purpose of first aid is to preserve life, assist recovery, prevent aggravation and minimize complication at the later dates with the help of such material as may be available.

13.1.1 EMERGENCY MEMO

13.1.1.1 **In accident requiring medical help, call** (keep address of minimum four Doctors)

Dr.

Address

Telephone No.

13.1.1.2 **In accidents requiring police, call:**

Police	Department Address	Telephone No.
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

13.1.1.3 **In accidents requiring ambulance call:**

Address

Telephone No.

Address

Telephone No.

13.2 GENERAL

13.2.1 Procedures outlined in this section are intended only to give a general knowledge of safe, effective methods of applying First Aid for certain types of injuries. Complete and detailed instruction is available in the books on First Aid.

13.2.2 Every person should be thought how to use each and every item in the First Aid Box, so that he/she can deal in emergency.

13.2.3 Rules framed by various States under sub section (1) of section 45 of the Factories Act, 1948 require keeping one copy of first aid leaflet issued by the Director General of Factory Advice Service and Labor Institute (DGFASLI), Government of India.

13.3 FIRST PRINCIPLES

13.3.1 Death is not to be assumed because signs of life are absent. It is much better to render First Aid to a dead body than to allow a living person to die for want of First Aid.

13.3.2 Keep the injured people lying down in a comfortable attention, no matter what other injuries are present

13.3.3 Severe hemorrhage must receive immediate attention, no matter what other injuries are present.

13.3.4 If the breathing has ceased, immediate measures must be taken to restore it.

13.3.5 Poisons swallowed should be got rid of or neutralized.

13.3.6 If the patient has received burns, attend to them.

13.3.7 When the patient has fractured a bone, no attempt must be made to move the patient until the bone has rendered as much immovable as practicable unless life is in danger from some other cause.

13.3.8 Treat the patient for shock.

13.3.9 Send for medical help by ambulance wherever possible.

13.3.10 Never give water or liquid to an unconscious patient. When the patient, returns to consciousness and is able to swallow, stimulants may given.

13.3.11 Don't let the patient see his own injury.

13.3.12 Use encouraging words to the patient.

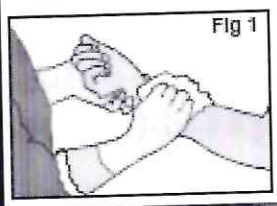
13.3.13 Keep the patient warm. Avoid over-zealous applications of external heat, but maintain normal body temperature.

13.4 EXTERNAL HAEMORRHAGE (BLEEDING)

13.4.1 BLEEDING WOUNDS

Bleeding wounds should be treated as follows:-

1. Put on your gloves.
2. Examine the injury - if any foreign objects are present leave them in place and dress around.
3. Open a dressing (fig 1) and place it firmly over the injury.
4. Apply firm pressure.
5. Secure the dressing.
6. Apply 1 dressing at a time up to a maximum of 2. If blood seeps through both dressings, remove them and apply a new dressing.
7. If dealing with a limb, keep the affected part elevated (fig 2).
8. If your casualty has lost a considerable amount of blood they may start to exhibit signs of shock.
9. Lay your conscious casualty down, conserve body heat and raise the legs (fig 3).
10. Reassure.







13.4.1.1 Elevate the bleeding part, except in the case of a fractured limb.

13.4.1.2 If wound is large or a foreign body or a fracture is suspected, apply pressure on pressure points or if necessary a tourniquet on the pressure points (listed at 2 below).

13.4.1.3 Refer two figures on page No.61.

13.4.1.4 Clean the wound and apply antiseptic all over the wound and surrounding skin and cover with a dry dressing. Cover the dressing with cotton wool, lint etc. and apply bandage over the dressing.

13.5 PRESSURE POINTS

Six principal pressure points, where hand or finger pressure against a bone may stop arterial bleeding are located as follows.

13.5.1 For Arties to Head and Neck

a) In the neck at the side of the windpipe against the back bone. Pressure in this area may produce unconsciousness or even more serious effect, hence it should be employed only as a last resort.

b) Just in front of the ear, against the skull.

c) About an inch forward from the angle of the jaw where a large branch crosses the jaw bone.

13.5.2 For Arteries to shoulder and Arm

a) Behind the inner end of the collar bone, down against the first rib.
b) On body side of the upper arm, halfway between the shoulder and elbow.

13.5.3 For Arteries to Lower Limbs

a) In the mid groin as it passes over the pelvic bone.

13.5.4 TOURNIQUET

A tourniquet should be a flat band at least 2 inches wide with a rope wire or sash-cord. Wrap the material twice around the limb, if possible, and tie a half knot. Place a short stick or similar article on the half knot and tie a square knot over it. Twist the stick rapidly to tighten the tourniquet. Don't tighten more than necessary to stop the flow.

Loosen the tourniquet every ten to fifteen minutes for 3 to 5 minutes to see if the bleeding has ceased or not, if the bleeding persists, the tourniquet should be tightened again.

REMEMBER

A tourniquet is always a dangerous instrument and should not be used if the bleeding can be checked readily otherwise.

Two convenient places for applying a tourniquet correctly to control bleeding are as follows:

a) Around the upper arm, about a hand breadth below the armpit.
b) Around the thigh, about the same distance below the groin.

Loosen the tourniquet every ten to fifteen minutes for 3 to 5 minutes to see if the bleeding has ceased or not, if the bleeding persists, the tourniquet should be tightened again.

13.6 INTERNAL HAEMORRHAGE.

13.6.1 BLEEDING FROM LUNGS

SYMPTOMS

13.6.1.1 If the bleeding is from the lung, the blood will be bright red and frothy and will be coughed up. If the bleeding is from the stomach the blood will look like coffee brown and is vomited.

13.6.1.2 Keep the patients lying on his back as flat as possible turn the head to one side for vomiting and coughing.

13.6.1.3 In such a case, the patient may be given a cube of ice to sock. Don't give any other thing by mouth; maintain warmth.

13.6.1.4 If intestine protrudes from the wound, do not attempt to touch or replace them. Apply satellite dressing and binder on wound.

13.6.1.5 Provide immediate transportation to hospital.

13.6.1.6 If the seat of hemorrhaged is known, apply an ice bag or a cold compress over the region.

13.6.1.7 Give nothing by mouth except in hemorrhage from the lungs when ice may be given.

13.6.1.8 Use encouraging words to the patient.

13.6.2 NOSE BLEEDING

a) Have the patient sit up with head thrown slightly back and breathing through the mouth; loosen his collar and everything tight around his neck.

b) Pinch the nose firmly just below the hard part. This encourages the clotting.

c) Apply cold compress on the bridge of the nose, nape of neck, also the spine at the level of the collar – place the feet in the hot water.

d) Warn the patient not to blow his nose.

e) If these measures do not stop the bleeding in a few minutes, a doctor is needed at once. Meanwhile gently a place a narrow strip of sterile gauze back into the nostril, leaving the end outside so that it can be easily removed.

13.6.3 BLEEDING EAR:

Lay the patient with the head slightly raised. Incline the head to the affected side and apply a dot dressing over the ear with loose bandage. Do not plug the ear. Apply pressure in front of the ear. Get the medical attention.

13.7 PHYSICAL SHOCK

13.7.1 CONDITION

Shock is a condition of sudden depression of the nervous system resulting from and occurring after every case of accident of sudden illness. It may vary from the slight feeling or faintness to a condition of collapse in which the vital forces of the body are so exhausted that death may result.

13.7.2 SYMPTOMS

Symptoms of shock are paleness of face and lips, cold moist skin, rapid, weak pulse, shallow, irregular breathing, fall of the body temperature, dilated pupils, nausea and vomiting may often occur.

13.7.3 TREATMENT

13.7.3.1 IMMEDIATE:-

a) Arrest severe haemorrhage if present.

b) Keep the patient lying on back with head low and turned to one side so that tongue falls sideways and does not fall backwards into throat to cause choking.

c) Loosen clothing about the neck, chest and waist and ensure a free circulation of fresh air.

d) Cover with rugs or coats.

e) Raise the lower limbs.

f) Apply smelling salts to the nose, except in the case of head injury.

g) Use encouraging words to the patient.

h) Ensure freedom from excitement and worry and avoid unnecessary questioning of patient, keep the patient comfortable.

i) Remove the patient to shelter.

13.7.3.2 ON ARRIVAL AT SHELTER

a) Wrap the patient in blankets and apply hot water bottles to the sides of the body, between the legs and to the feet. it should be remembered that it is easy to burn a victim of shock because his sensations are not normal. Too much heat can be dangerous. Always test temperature of heated objects against your own face or wrist before your wrap them in a cloth or a paper.

b) If the patient is able to swallow, give freely hot strong tea or coffee with plenty of sugar, except when injury to an internal organ is present or suspected.

Do not pour fluids down the throat of unconscious persons. Avoid alcoholic stimulants.

13.8 FAINTING

1) Lower patient's head between knees, loosen tight clothing around neck. If impossible to lower victim's head, elevate his lower limbs and keep him lying down until recovery seems assured. If unconsciousness persists, cover the patient and call physician.

2) Sprinkle the face with hot and cold water alternatively and apply warmth to the pit of the stomach and over heart. Vigorous rubbing of the linbs upwards has a stimulating effect. Smelling salts may be held to the nose.

13.9 SUNSTROKE AND HEATSTROKE

13.9.1 CAUSE

Sunstroke and heatstroke have the same symptoms, but the cause may be slightly different. Sunstroke results from excessive direct exposure to the sun's rays, while heatstroke results from excessive indoor heat such as in boiler rooms.

13.9.2 SYMPTOMS

Red and flushed face, hot dry skin, no sweating, rapid and strong pulse, very high temperature, headache and usually unconsciousness.

13.9.3 TREATMENT

Lay the victim with head elevated, sponge his body with cold water continuously and apply ice bags to head and spine, until symptoms subside. Keep the patient under the fan. Record body temperature every ten minutes; when the temperature falls to 30 degree C, stop pouring water. When consciousness returns patient may be given Epson or Glauber salt water and also give drinks of cold water freely. Send the patient to the hospital.

13.10 HEAT EXHAUSTION

13.10.1 CAUSE

Heat exhaustion is caused by direct exposure to the sun's rays or by indoor heat.

13.10.2 SYMPTOMS

Pale face, cool, moist skin, profuse sweating, weak pulse, low temperature, often faint but seldom unconscious for more than a few minutes.

13.10.3 TREATMENT

Keep the patient's head low, give salt, coffee or tea may be given. External heat needed in severe causes.

13.11 FRACTURES

13.11.1 SYMPTOMS

Swelling, tenderness, loss of Power, Deforming.

13.11.2 Treatment:-

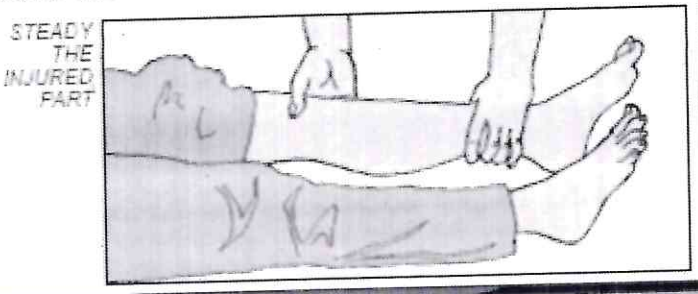
a) Make sure that part of the fractured area is immovable by the uses of bandage using the injured body as supports or by well padded splint.

b) Remove the injured to a hospital; handle him carefully to prevent ends of bones cutting trough flesh. Transport on a rigid frame, if backbone is fractured. This frame is improvised by using available boards. The rigid frame is to be placed on a structure for transportation.

c) Move the body of injured person lengthwise (not sideways) and head first, with his head and neck carefully supported.

d) Refer the figure on the next page .

1. Instruct the casualty to remain still.
2. Do not attempt to move the affected part.
3. Examine the injury for any blood loss - treat this first.
4. If any bone protrudes from the injury do not touch it, if blood loss is evident build your dressings up around it rather than over it.
5. The casualty will find the most comfortable position and will not be keen to have the injury touched.
6. If the casualty cannot maintain a stable condition for themselves you may provide assistance or stabilise the injury with your hands.
7. Call the EMS.



13.11.3 TRANSPORTATION OF PATIENTS

Do not be hurried into moving an injured person. Always be careful in handling and transporting an injured person. Improper or careless methods frequently increase severity of injury and may ever cause death. Acquaint yourself with the various methods of carrying and transportation.

13.12 ANIMAL BITES

Special danger from bits of an animal, such as a dog, jackal, fox or wolf suffering from rabies is of hydrophobia.

13.12.1 Arrange for medical help immediately.

13.12.2 After a person has been bitten by a rabid animal, every effort should be made to promote bleeding so as to wash the wound from within outwards.

13.12.3 Give alcohol such as brandy or whisky or hot black coffee.

13.12.4 If it is not possible to obtain the services of a doctor within a few minutes of the person being bitten, the wound should be cauterised. This is best done by applying a fluid caustic, such as carbolic or nitric acid on a match or a piece of wood cut to a point or lupar caustic. To be effective, every tooth mark must be probed and cauterized separately as only so doing can virus be destroyed.

13.13 SNAKE BITE

13.13.1 If a person is bitten by a poisonous snake, two small punctured wounds (fang marks) about 1.2cms apart will be seen: these marks will be shown by tow tiny drops of blood. If there are more scratches, the snake is most likely to be non-poisonous.

13.13.2 For poisonous snake bites, immediate treatment is necessary to prevent the poison spreading throughout the body.

13.13.3 TREATMENT FOR SNAKEBITE

13.13.3.1 Send for the Doctor.

13.13.3.2 If the bite is on limb, immediately stop circulation by means of a constriction on the upper arm or thigh. The constriction may be handkerchief, necktie, shoestring, bandage or rubber tubing; should be tight enough to prevent the return of blood in the surface vessels to heart but not tight enough to affect the deeper arteries and veins. The constriction should be kept in position for twenty minutes, then relaxed for one minute or until the skin becomes pink and again tightened. Repeat this procedure until the arrival of the doctor.

13.13.3.3 Make parallel 2 to 3 cms. long 0.5 cms deep incisions with a clean knife or blade at the site of bite. The wound should be allowed to bleed freely. Never suck the blood from wound.

13.13.3.4 Keep the patient absolutely at rest and instill confidence in him.

13.13.3.5 If the patient is able to swallow, give hot drinks such as strong coffee, tea or milk. Avoid alcohol.

13.13.3.6 Wash the wound, preferably with (very light pink) solution of potassium permanganate, or with soap or Dettol.

13.13.3.7 If breathing is falling, apply artificial respiration. Treat for shock, arrange immediate hospitalization.

13.14 DOG BITE

Wash the wound immediately with water, wash with potash solution, soap and water or Dettol, and do not try to stop bleeding. Cover the wound with a sterile dressing. Send the patient to hospital for further treatment. Watch the dog for 10 days.

13.15 INSECT STINGS

13.15.1 Avoid swift movements. Do not swat the insect. Remove the sting, using forceps or tweezers or the point of a needle which has been sterilised through a flame.

13.15.2 Cold compressions apply vinegar diluted with water, ether mentholated spirit, weak ammonia or salvalatile, sodiocarb paste should be applied at the site, e.g. wrap the wound with an ice packed cloth.

13.15.3 If the sting is on the mouth, give a mouth wash of soda bicarb.

13.16 BURNS

13.16.1 Burns are caused by heat or any kind of friction and chemicals such as acids and alkalis. Burns are classified accordingly to degree as follows-

a) First degree:-skin reddened.

b) Second degree:-skin blistered.

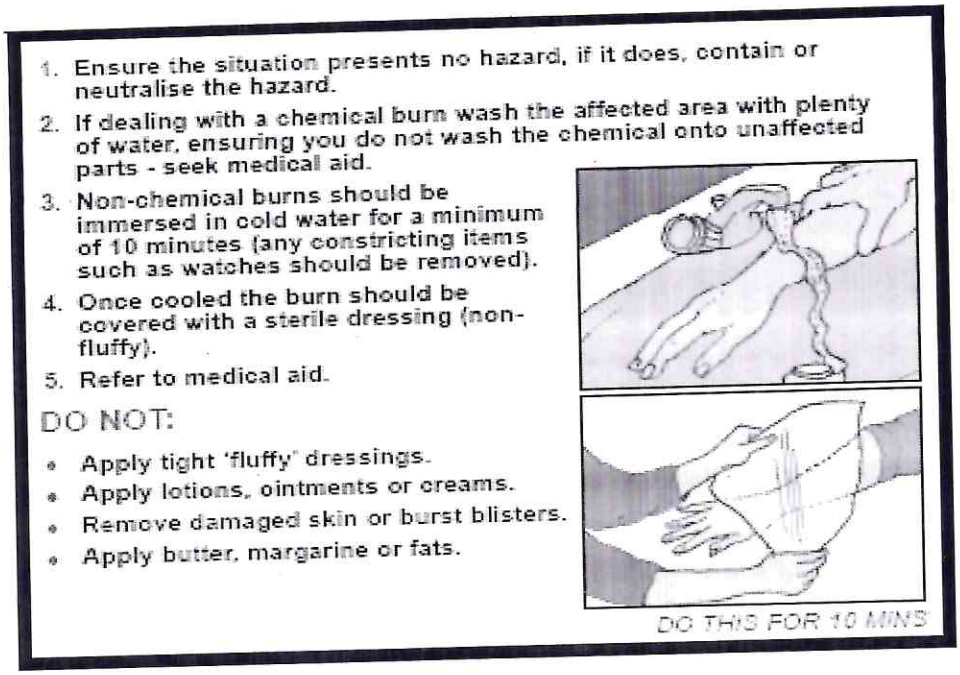
c) Third degree:-Deeper destruction of tissues, such as charring or coking.

13.16.2 ELECTRICAL BURNS

Two kinds of electrical burns occur:

13.16.2.1 When current passes through the body burning or destroying tissues as it goes, it makes a deep third degree burn which may be smaller on surface than below and slow to heal.

13.16.2.2 Flash burns of the skin are not usually deep and are first or second degree. Flash burns of the eye may not show up until sometime later. In first aid flash burns of the eye, light should be excluded by using a moist compress held lightly in place with a bandage.



13.16.2.3 Eye burns should have a doctor's attention as soon as possible.

13.16.2.4 First aider's duties are to relieve pain, prevent infection and treat for shock, cover the burns with clean cloth as it is important to exclude air from the burns as quickly as possible as with clean cloth as it is important from entering. Death in a day or two after a burn is usually the result of shock. Death later is chiefly the result of infection.

13.16.2.5 For burns of limited extent, apply sterile petroleum such as Vaseline or burn ointment over the burnt area. Cover ointment with a layer or two of fine mesh gauze and secure with a roller bandage. Take the patient to a doctor for further treatment.

13.16.2.6 Extensive burns may be much more serious. Shock is always present. Keep the victim lying down with his hand low and avoid exposure to cold. Leave his clothing on, cover him with blankets and get him to a hospital as quickly as you can.

If hospital is not nearby, then remove all loose clothing from the burned are unless it sticks to skin. Cut the adhering cloth around the burn and leave the remainder laundered sheeting into a solution of baking soda or Epson salt in warm tap water, (using three table spoonful to a quart) and apply to burned area. Keep the patient covered and wait until the doctor arrives.

13.16.3 CHEMICAL BURNS

13.16.3.1 Burns by an acid, or an alkali should be washed immediately with large quantities of water until chemical is thoroughly washed away. Then apply an ointment dressing and send for medical help.

13.16.3.2 Carbolic acid burns should be first washed by sponging with rubbing alcohol, if possible.

13.17 EYE INJURIES

13.17.1 Loose particles may be removed with the corner of clean bandage or handkerchief. If the particles cannot be removed easily relieve the irritation with a few drops of olive oil, mineral oil or castor oil and consult a doctor promptly.

13.17.2 For a foreign particle impeded in the eyeball, do not attempt to remove it but drop medical paraffin or Caster oil on the eyeball after pulling down the lower eyelid, close the lids, apply a soft pad of cotton wool and secure it by a bandage tied sufficiently firm to keep the eyeball steady till medical aid is available.

13.17.3 When quicklime or corrosive acid or alkali is in the eye, wash the eye continuously and freely with water.

13.17.4 For the treatment of blockage spirit must not be used.

13.18 SPRAINS AND STRAINS

13.18.1 **SPRAIN**

When the ligaments and parts around a joint are stretched or torn, the joint is said to be sprained. Sprains are usually accompanied by discoloration of the joint.

a) Place the joint and apply a firm bandage.
b) Expose the joint and apply a firm bandage.
c) Wet the bandage with cold water and keep it wet.

13.18.2 **STRAIN**

The overstretched muscles or tendons are said to be strained.

13.18.3 **TREATMENT**

a) Place the patient in the most comfortable position and prevent any movement
b) Apply a hot compress.

13.19 BRUISES

A bruise is caused by a blow which breaks the small blood vessel, in the tissues under the skin.

Apply immediately ice or cloth wrung out of every cold water or place of lint soaked in equal parts of spirit and water to prevent discoloration, keep down the swelling and relieve pain.

13.20 POISONING

13.20.1 Find the nature of poisoning – Give universal antidote mixture to drink.

Charcoal powder – 2 table spoons

Coffee powder – 2 table spoons

Chalk powder – 1 table spoons

Add warm water in glass and mix well.

13.20.2 Preserve the vomit for the doctor to examine later.

13.20.3 Send patient quickly to the hospital.

13.21 RESCUE BREATHING

'TS THE CASUALTY BREATHING?

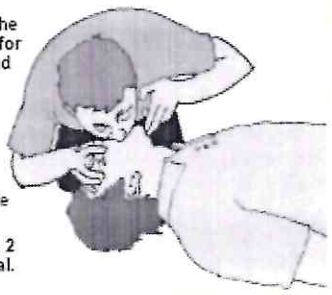
Look for movement. Listen for breathing / lifesigns. Feel for airflow.

If casualty is breathing normally

1. Turn him into the recovery position
2. Check for continued breathing.
3. Send someone for assistance or, if you are on your own, leave the casualty and go for assistance yourself.

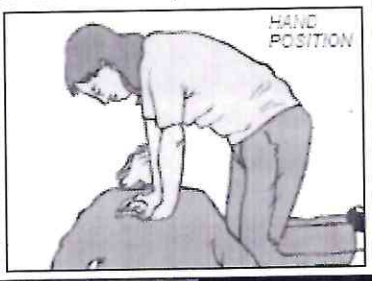
If casualty is not breathing

1. If you are on your own, leave the casualty at this stage and call for help. Return to the casualty and open the airway.
2. Seal the nostrils with your thumb and forefinger.
3. Blow steadily until you see their chest rise.
4. Remove your mouth to the side and take in some 'Fresh Air'.
5. Repeat so that you have given 2 effective rescue breaths in total.



1. Ensure the casualty is on a firm, flat surface.
2. Locate the Sternum (the flat bone located centrally in the chest which joins the ribs together).
3. Place the heal of one hand on the lower sternum (approximately 2 fingers up from its base. Place the heel of the other hand on top of this hand and interlock the fingers.
4. Compress the chest (up to a maximum depth of approximately 4-5cm, 15 times at a rate of approximately 2 compressions per second) and give 2 rescue breaths.
5. Repeat above eg. 2 rescue breaths and 15 compressions.





ASSESS THE CASUALTY FOR SIGNS OF CIRCULATION

1. Look, Listen and Feel for normal breathing, coughing or movement.
2. Only if you are trained to do so, check the carotid pulse.*
3. Take no more than 10 seconds to do this.

NOT BREATHING, SIGNS OF LIFE PRESENT

1. Apply 10 rescue breaths (See 'Breathing' below).
2. After every 10 rescue breaths re-check the circulation.

NOT BREATHING, SIGNS OF LIFE ABSENT

1. Apply 2 rescue breaths.
2. Now give 15 compressions.
3. Repeat the above eg; 2 rescue breaths and 15 compressions.
4. Continue until the casualty recovers or help arrives.



13.21.1 This could mean the difference between life and death. Drowning, electric shock, choking after inhaling something, suffocation from things such as smoke, fumes or gas, these are instances when rescue breathing becomes necessary.

13.21.2 Lay the victim flat with his head well back and chin up. Place your mouth right over his, keeping his nose covered at the same time, either with your hands or cheek. Now gently breathe out into the person's mouth till his chest rises then takes your mouth away and take another breath. This should be repeated about 12 times a minutes.

13.21.3 Give external cardiac massage.

13.21.4 Transport the patient to hospital.

13.21.5 Refer the four figures.

13.22 FIRST AID BOX

13.22.1 A First Aid Box is an essential medical unit in any habitual premises. It ensures tiding over the crisis by avoiding last minute hunts. It should be kept at accessible place and bare essentials stored in it. Each item must be replaced, as soon as it gets used up.

13.22.2 The essential items to be preserved in a First Aid Box are given in the annexed list.

Contents of First Aid Box

Sr. No	Content	Quantity
1.	Wound dressing (sterilized) a) Cm wide roll b) Cm wide roll	 6 nos. 3 nos.
2.	Burn dressing (sterilised) Large	3 nos.
3.	Adhesive plastering (for fastening dressing) 2 cm x 1 mtrs.)	1 no.
4.	Safety pins (for fastening bandages)	1 Bunch
5.	Washable Bandage	6 nos.
6.	Triangular Bandage (for fractures) – large	1 no
7.	Scissors (of fastening bandages)	1 pair
8.	Scissors (of stainless steel) 8 cm plank	1 pair
9.	Absorbent cotton wool (for cleaning wound)	100 gms
10.	a) Potassium permanganate b) Tincture Iodine B.P (for all wound) c) Dettol or Savlon d) Hydrogen peroxide (Antiseptic and bleeding stopper)	1 bottle 1 bottle 1 bottle 1 bottle
11.	Snake bite lancet	1 no
12.	Burn Ointment (for burns, cuts & insect bites) e.g. Burnol	1 tube
13.	a) Soda-bi-carp, BP (For acid burns) b) Vinegar (for Alkali burns)	1 bottle 1 bottle
14.	Tourniquet (for stopping bleeding)	1 set
15.	a) Eye drop b) Sterilised eye pads (separate by seal)	1 bottle 6 nos.
16.	Anti Allergy tablet (avil or pyrigesic)	50 nos.
17.	Analgesic tablet (crocin or pyrigesic)	100 nos.

18.	a) Spirit of Sal volatile b) Smelling salts	1 bottle 100 gms
19.	First Aid Leaflet	1 copy