# SAFETY MANUAL
# OF

# NORTH EASTERN ELECTRIC POWER CORPORATION LTD.

| PREPARED BY | REVIEWED BY | CHECKED BY | RECOMMENDED BY | APPROVED BY |
|---|---|---|---|---|
| NEEPCO | NATIONAL SAFETY COUNCIL | ED (S&S) | DIRECTOR (T) | CMD |

Rev. No. 02

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# NORTH EASTERN ELECTRIC POWER CORPORATION LTD.

| PREPARED BY<br>F&S, WING, SHILLONG | CHECKED BY<br>DY. GENERAL MANAGER (IT) | APPROVED BY<br>GENERAL MANAGER (HR) |
|---|---|---|
| 15/05/2023 | 15/05/2023 | 15/5/23 |

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## INTRODUCTION

### THE BACKGROUND

The Management of NEEPCO requested National Safety Council (NSC), Navi Mumbai to revise their safety manual, accordingly, the field visit was conducted from 27-31 August 2017 at AGBPP and KHEP plant by a team comprising of following experts: Shri. Akshay V. Hotkar, Assistant Director, NSC & Shri M G Joseph, Member, NSC Experts Panel. Shri Dambeswar Hazarika, from corporate Safety was mainly assigned the responsibility as coordinators for liasoning with the team. He accompanied the team during the field visit and coordinated to furnish necessary information and documents for perusal. During the course of the field visit, interaction was made with various personnel in different departments in the above said plants.

### SCOPE & OBJECTIVE OF WORK

The scope and objective of work is to review and revise the safety manual of the NEECO at corporate level.

### INTRODUCTION OF NEEPCO

NEEPCO was established under the Companies' Act 1956 on 2nd April 1976 with its registered Head Office at Shillong, Meghalaya. It is a Schedule 'A' Enterprise since 15th July 2008 and a Miniratna Category-I Enterprise since 8th April 2013 with authorized share capital of Rs. 5000 Crore.

NEEPCO's mission is to harness the power potential of the country, from conventional and non-conventional sources, with minimal impact on the environment, through planned development of power generation projects by an integrated approach covering all aspects of investigation, planning, design, construction, operation and maintenance of power projects, which in turn would effectively promote the development of the nation as a whole.

NEEPCO has so far commissioned 6 Hydro projects and 3 Gas Based Thermal Projects and one Solar Project with total installed capacity of 2057 MW which comprises of 1525 MW of Hydro, 527 MW of Thermal Power and 5 MW of Solar power respectively.

Being a premier power generating company in the North East, NEEPCO's contributes about 40% of the region's energy requirement. NEEPCO has been consistently making profit of more than Rs. 200 Crs. since 2006-07.
ISO CERTIFICATION: Availability and reliability of power generation by NEEPCO is due to adherence to international standards by adapting to best business processes. All operational plants including the Corporate Office are accredited to:

- Quality Management System (ISO 9001:2015)
- Environmental Management System (ISO 14001:2015) and
- Occupational Health and Safety Management System (ISO 45001:2018)

PROJECTS TO BE TAKEN UP:

With a Mission to harness the vast Hydro and Thermal Power potential of the NE Region of the country, NEEPCO is committed to bring about a significant socio economic development of the region in a planned and sustainable manner. Apart from its present area of operation, NEEPCO is also planning to spread its wings to other areas of the country outside the NER. NEEPCO has chartered out plans for expansion of its domain by taking up various projects aggregating 5193 MW for execution in the coming future which are as below.

Wah Umiam St- III HEP- 85 MW, Wah Umiam Stage – I HEP- 50 MW, Wah Umiam St – II HEP – 100 MW, New Melling HEP – 90 MW, Nafra HEP – 120 MW, Naying HEP – 1000 MW, Tato – II HEP – 700 MW, Tawang – I HEP – 600 MW, Tawang – II HEP – 800 MW, Hirong HEP – 500 MW, Pauk HEP – 145 MW, Heo HEP – 240 MW, Tato – I HEP – 186 MW, Talong (Londa) HEP – 225 MW, Sankangrong HEP – 45 MW, Simang - I HEP – 67 MW, Simang – II HEP – 66 MW, Phanchung (Pachi) HEP – 56 MW, Khuitam HEP – 66 MW & ParHEP – 52 MW.

NEEPCO is in continuous search of opportunities to effectively utilize its experience and expertise in power project development and operation so as to exploit the available potential both domestic and international with active co-operation from the Central as well as State Governments.

## CHAPTER 1: NEEPCO SAFETY POLICY

NEEPCO consider safety affairs to be essential and integral part of its business, having a direct impact upon its operations, as such it accepts its responsibility for establishing and maintaining safe working environment for all its employees and property. This responsibility arises from:

i) Corporation's statutory responsibility in respect of health, safety and welfare of employees emanating from the relevant legislations.

ii) Corporation's moral responsibility towards its employees to provide the best practicable working condition from the point of view of health and safety.

iii) The obligation to consult with its staff and their representatives to implement policies and procedures developed as a result of discussions.

The Corporation shall take all such steps which are reasonably practicable to ensure best possible conditions of work, and with this end in view the Corporation shall do the following:

1. To allocate sufficient Safety resources to provide and maintain safe and healthy atmosphere and conditions at of work.
2. To take steps to ensure that all known safety factors are taken into account in the design, construction, operation & maintenance of plants, machinery & equipment, safety, environment. etc.
3. The Safety Manual is to serve as an instrument for creating Safety Consciousness among the employees at all level of the Organization.
4. To provide wherever necessary protective equipment, safety appliances and clothing and to ensure their proper use.
5. To inform employees about materials, equipment or process used in their work which are known to be potentially hazardous to health, safety and property.
6. To keep all operation & maintenance under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge.
7. To provide appropriate facilities for first-aid and prompt treatment of injuries and illness at work.
8. To provide appropriate instruction, training and supervision in safety and first-aid, to ensure that adequate publicity is given to these matters.
9. To ensure proper implementation of appropriate safety service with training facilities to its Safety personnel.
10. To ensure that professional advice is made available wherever potentially hazardous situation exist or might arises and take corrective, remedial and preventive action.
11. To ensure and inspect of all buildings, equipment, work place, operation and process involved in the project.
12. It shall be the endeavour of the Corporation to progressively identify, control & eliminate all the hazardous conditions, which present risk to the employees and /or possible damage & loss to the plant and equipment including product (Power Generation).

## CHAPTER 2: SAFETY ORGANISATION

### A. Safety Officer:

A qualified safety officer shall be appointed as prescribed by relevant act and rules at every construction as well as O&M plant where the number of employees, including contract workers, exceeds five hundred and a suitable officer shall be designated as safety officer where the number of employees is less than five hundred, provided that, where number of employees exceeds one thousand, one more safety officer shall be appointed for every additional one thousand employees. A person shall not be eligible for appointment as a safety officer unless he is qualified –

(i) Under section 40-b of the Factories Act, 1948 (63 of 1948) and rules made thereunder **for O&M plant**; or

(ii) Under sub-section (2) of sections 38 of the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (27 of 1996) and rules made thereunder **for construction site**.

Where number of safety officers appointed exceeds one, one of them shall be designated as chief safety officer who shall have higher ranking than the others and he shall be in-charge of the safety functions and the other safety officers shall work under his control. The chief safety officer or the safety officer, as the case may be, shall be given the status of a senior executive and he shall work directly under the control of the plant head or chief Executive. The safety officer shall be appointed before start of construction activities and the safety set-up chart shall be prepared and properly displayed at a conspicuous place.

### B. Electrical safety officer:

All suppliers of electricity including generating companies, transmission companies and distribution companies shall designate an Electrical Safety Officer for ensuring observance of safety measures specified under regulation 5 of Central Electricity Authority (Measures relating to Safety & Electric Supply) Regulations, 2010, in their organization for construction, operation and maintenance of power stations, sub-station, transmission and distribution lines.

The Electrical safety officer shall be an Electrical Engineering degree holder with at least **Five years** of experience in operation and maintenance of electricity plants or an Electrical Engineering Diploma holder with at least **Ten years** of experience in operation and maintenance of electrical plant.

The electrical Safety Officer shall ensure periodic inspection of such installations, get them tested and keep a record thereof and such records shall be made available to the Electrical Inspector if and when required.

### C. Safety Committee:

In every Project/Plant where 250 or more workers are directly or indirectly employed or which carries on any process or operation declared to be dangerous under section 87 or which carries on hazardous process as define**d** under section 2 (cb) of the Factories Act, 1948, there shall be a safety committee.

The safety committee shall be constituted for the plant/project to advise the management in improving the safe working environment of workplace. The safety committee shall consist of equal number of representatives of workers and management and shall promote co-operation between the workers and the management for maintaining proper safety and health at work place. The constitution of safety committee and its members shall be authorized by the occupier or factory manager or plant head through official circular.

A senior official, who by his technical qualification and position in the organization can contribute effectively to the functioning of the committee, shall be the chairman. Safety officer and medical officer wherever available shall be the member and in such case safety officer shall be the secretary. In addition to the above, from the management side, one representative each from the production, maintenance, purchase and personnel department shall be the member. The worker's representatives in the safety

committee shall be such as to represent majority of the shop floor. Safety committee shall meet as often as necessary but not less than once in a quarter. Any safety committee member absent for more than 1 safety committee meetings in a year, then the person shall give letter to chairman explaining his reason(s) for not attending the meetings.

The tenure of the committee shall be two years. The minutes of the meeting shall be recorded and circulated with action plan with target dates and responsible person. All points raised in the meetings shall be complied by respective person / department and compliance report should be sent to safety committee secretary and chairman. All these points shall be monitored by safety committee chairman and secretary.

For corporate head quarter and offices outside Shillong, safety committee shall consist of equal number of representatives of worker and management. Their composition and functioning will be same as for projects / plants.

**Note**: - For appointment/placement of Safety Officer and formation of a Safety Committee in every Plant/Project is to be done irrespective of nos. of employees engaged. This is as per Clause No. 40B of The Factories Act, 1948 wherein it is desired to post Safety Officer in any manufacturing process or operations which involves any risk of bodily injury, poisoning or disease, or any other hazards to health to the person employed in the factory.

Function and duties of safety committee shall also include:

(a) Assisting and co-operating with the management in achieving the aims and objectives outlined in the Health and Safety Policy of the occupier;
(b) dealing with all matters Concerning health safety and environment and to arrive at practicable solutions to problems encountered;
(c) creating safety awareness amongst all workers;
(d) undertaking educational, training and promotional activities;
(e) discussing reports on safety, environment and occupational health surveys, safety audit, risk assessment, emergency and disaster management plans and implementation of the recommendation made in the reports;
(f) carrying out health and safety surveys and identifying causes of accidents;
(g) looking into any complaint made on the likelihood of an imminent danger to the safety and health of the workers and suggesting corrective measures;
(h) reviewing the implementation of the recommendations made by it.

If due to the size of the factory, or any other reason, the above functions cannot be effectively carried out by the Safety Committee, then establish sub-committees (like department wise safety committees) may be required to assist it.

## CHAPTER 3: ACTS, RULES, REGULATIONS AND OTHER PUBLICATIONS APPLICABLE FOR THE PLANT/PROJECT RELATED TO SAFETY

### A. ACTS, RULES AND REGULATIONS:

| Sl. No. | | Acts, Rules & Regulations |
|---|---|---|
| 1 | a | The Factories Act, 1948 |
| | b | The State Factories Rules |
| | c | State Factories (Safety Officers) Rules |
| 2 | a | The Building & Other Construction Workers (Regulation of Employment & Conditions of Services) Act, 1996 |
| | b | The Building & Other Construction Workers (Regulation of Employment & Conditions of Services) Central Rules, 1998 |
| | c | The Building & Other Construction Workers' Welfare Cess Rules, 1998 |
| 3 | a | The Motor Vehicles Act, 1988 (amended 2001) |
| | b | The Central Motor Vehicles Rules, 1989 (amended 2005) |
| 4 | a | The Explosives Act, 1884 (amended 1983) |
| | b | The Explosives (Amendment) Rules, 2010 (replaces the Explosives Rules, 1983, 2005 & 2008) |
| | c | The Static & Mobile Pressure Vessels (unfired) Rules, 1981 (amended 2002) |
| | d | The Gas Cylinders (Amendment) Rules, 2010 (replaces the Gas Cylinders Rules, 1981 and 2004) |
| | e | The Liquefied Petroleum Gas (Regulation of supply and distribution) Order, 2000. |
| 5 | a | The Petroleum Act, 1934 |
| | b | The Petroleum Rules, 2002 (replaces the Petroleum Rules, 1976) (amended 2007) |
| 6 | a | The Electricity Act, 2003 (replaces the Indian Electricity Act,1910) (amended 2007) |
| | b | The Electricity Rules, 2005 (replaces the Electricity rule, 1956 (amended 2006) |
| | c | Central Electricity Authority (Safety Requirements for Construction, Operation & Maintenance of Electrical Plants & Electric Lines) Regulations, 2011. |
| | d | Central Electricity Authority (Measures relating to Safety & Electric Supply) Regulations, 2010. |
| 7 | a | The Boiler Act, 1923 |
| | b | The Boiler Regulation, 1950 |
| 8 | a | The Dangerous Machines (Regulation) Act, 1983. |
| | b | The Dangerous Machines (Regulation) Rules, 1984. |
| 9 | | The Fatal Accidents Act, 1855. |
| 10 | | The Disaster Management Act, 2005. |
| 11 | a | The Environment (Protection) Act, 1986 (amended 1991) |
| | b | The Environment Protection Rules, 1986 (amended 2010) |
| | c | The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (amended 2000) |
| | d | The Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008 (amended 2009) (in supersession of the Hazardous Waste (management and Handling) Rules, 1989) |
| | e | The Bio-medical Waste (Management & Handling) Rules, 1998 (amended 2003) |
| | f | The Noise Pollution (Regulation and Control) Rules, 2000 (amended 2010) |
| | g | The Batteries (Management and Handling) Rules, 2001. |
| | h | The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996. |
| | i | The Municipal Solid wastes (Management and Handling) Rules, 2000. |
| | j | The Environment Clearance of Project Notification, 1994 |
| | k | The Air (Prevention & Control of Pollution) Act, 1981 (amended 1987) |
| | l | The Air (Prevention & Control of Pollution) Rules, 1982 |
| | m | The Water (Prevention & Control of Pollution) Act, 1974 (amended 1988) |
| | n | The Water (Prevention & Control of Pollution) Rules, 1975 |
| | o | The Water (Prevention & Control of Pollution) Cess Act, 1977 (amended 2003) |
| | p | The Water (Prevention & Control of Pollution) Cess Rules, 1978 |

**B. OTHER PUBLICATIONS:**

1. Indian Standards
2. National Building Code
3. National Electrical Code
4. Publications of National Institute of Disaster Management

**Note: -** Any replacement or amendment of the above Acts, Rules, Regulations and other publications made by the concerned authority and published in the union govt. or state govt. gazette, ordinary or extra ordinary or otherwise shall be applicable to the all establishment of NEEPCO.

## CHAPTER 4: RESPONSIBILITIES OF EMPLOYEE

### A. General Responsibilities:

NEEPCO Management and site personnel will ensure that site conditions within their scope of work shall conform to the safety requirements. It is the responsibility of all site personnel; Contractors and Subcontractors to act in accordance with the procedures and policies described in the safety manual and Customer requirements. Individuals who are found to be in violation of these procedures and policies may have action taken against them up to and including removal from the project site. Safety responsibilities for specific positions are described in the following subsections. NEEPCO shall have the right to stop work or any activity that, in its opinion, may impact the safety of employees or the environment. Review by NEEPCO of any aspect of the Contractor's program, plans or activities shall not relieve the Contractor of their obligation to fully meet the requirements of applicable law and these requirements.

### B. Head of Plant/Project:

Ensure adequate and suitable resources are allocated to the project to enable the project to be completed, while complying fully with the requirements of all applicable regulatory requirements.
He shall incorporate the safety provisions in the contract document which are required to be complied by the contractor's employees during execution of the contract to facilitate safe working during execution of the work.
A site safety plan shall be submitted by the contractor before award of work which shall be recommended by safety officer and approved by project authority. The Plan shall be site specific. Moreover, the plan will identify all safety requirements that need to be implemented to ensure compliance with applicable regulatory requirements.
Also ensure that the resolution of any issues are incorporated into the Site safety plan and communicated to site personnel. Ensure that all potential contractors shall receive a copy of this approved site safety plan before commencement of work to be completed on site.

The Occupier / head of a factory shall provide each Safety Officer with such facilities, equipment and information as necessary to enable him to discharge his duties effectively.

### C. Safety Officer:

The safety officer shall advise and assist the occupier or owner in fulfillment of his responsibilities concerning prevention of personal injuries and maintaining a safe working environment. The safety officer shall be authorized to stop the execution of any work which in his judgment is unsafe and may result in injury to any person and he shall also have the power to remove the employees or contract workers from the site, if they are found not using personal protective equipment or in unsafe practice or procedure. He shall advise and assist in preparing report of investigation of accidents and dangerous occurrences. Provide occupational health and safety support to the Head of Plant/Project, Site in-charge and other staff as required. He shall conduct safety committee meeting as stipulated. Arrange safety awareness programme, safety training and safety inspection/observation. The safety officer is responsible for Internal reporting of incident and accident and maintaining of statistics.

**Duties of Safety Officer shall include:**

1) The duties of a Safety Officer shall be to advise and assist the Factory management in the fulfillment of obligations statutory or otherwise concerning prevention of personal injuries and maintaining a safe working environment.
(2) Without prejudice to the generality of the provisions of above, such duties may include:
   (i) to advise the concerned departments in planning and organizing measures necessary for the effective control of personal injuries and industrial diseases

(ii) to advise on safety aspects of all jobs and to carry out detailed job safety analysis of selected jobs
(iii) to carry out safety inspections in order to identify unsafe plant or equipment and hazardous conditions of work, and carry out safety observation to identify unsafe work practices and procedures followed by workers, and to suggest measures to be adopted for remedying defects found
(iv) to advise and assist on matters relating to carrying out safety inspections and Safety observations by concerned Department
(v) to design and conduct, either independently or in collaboration with the training department, suitable training and educational programmes for all levels in the organizations and specifically for the supervisory staff for the prevention of personal injuries and industrial diseases
(vi) to check and evaluate the effectiveness of the action taken or proposed to be taken to prevent personal injuries and industrial diseases
(vii) to advise the purchasing and store departments on the availability and the specifications of any new machinery, plant, appliance or equipment including personal protective equipment, to be installed or used in the factory in order to ensure high standard of safety and protection of health of the employees
(viii) to advise concerned departments on matters relating to reporting and investigation (causes of industrial accidents and diseases)
(ix) to investigate into the causes and circumstances of every fatal, serious and selected accident and dangerous occurrence, compile necessary reports, and tender advice to prevent their recurrence
(x) to investigate into the cases of every industrial disease:
(xi) to promote setting up of safety committees and act as adviser and Catalyst to such committees
(xii) to organize, in collaboration with the concerned departments, Campaigns, competitions, contests and other activities which will develop and maintain in the interest of the workers in establishing and maintaining safe conditions of work and procedures
(xiii) to advise on the maintenance of records as are necessary relating to accidents, dangerous occurrences and industrial diseases and present information in appropriate form for the use of management and others in assessing safety performance
(xiv) to maintain liaison with other departments, in the factory including medical and training departments, and with the Directorate of Factories, Fire Services, local authorities and other organizations engaged in the promotion of industrial safety.

No Safety Officer shall be required or allowed to do any work which is inconsistent with, or detrimental to the performance of the duties mentioned above.

**D. Engineer in-charge / Site in-charge:**

Ensure implementation of safety manual and site safety plan. Ensure all works, acts and emissions on site under the responsibility of NEEPCO, comply fully with all applicable regulatory requirements. Ensure implementation and execution of the Lock-Out Tag-Out (LOTO) program, including training, development and revision of procedures, and periodic auditing of program compliance. Ensure all workers on site only proceeds when risk assessments have been completed, and communicated to those who can be impacted by the hazards identified. Support or participate in the investigation of all accidents and reportable occurrences. Ensure adequate facilities, procedures and trained personnel are available for all foreseeable emergencies. Ensure all personnel wear all required PPE for the environment they are in and the tasks they are performing. As applicable to site activities, support obligations to protect adjacent property, ensure safety of third party employees, and ensure the safety of the public. Not knowingly permit any construction means, methods, techniques, or activity which compromises safety and health in the workplace. Take responsibility for the project's environmental performance and ensure that all operations comply with environmental policies and all relevant regulatory requirements. Enforce the Project Safety Program including documentation of disciplinary actions taken for violations of established rules, regulations, procedures, and programs.

**E. Other employees:**

They are responsible for:

1. abiding by the orders and instructions of the management/authority regarding maintaining safety,
2. abiding by the instructions of supervisor and site engineer regarding maintaining safety,
3. following safety rules and regulations,
4. maintaining high degree of personal hygiene.
5. use of proper safety equipment/personal protective equipment and clothing,
6. safe keeping of safety equipment/personal protective equipment,
7. avoiding unsafe acts,
8. intimating about unsafe conditions of the plant, equipment, machinery and working area to the supervisors and site engineers if noticed,
9. intimating about defective machineries, equipment, tools, tackles, chains, ropes, pulleys and other lifting and hoisting equipment to the supervisors and site engineers if noticed,
10. maintaining cleanliness of the work area,
11. proper use of tools, tackles, chains, ropes, pulleys and other lifting and hoisting equipment, dustbin, waste bin, spittoon, toilet etc.,
12. not using any intoxicated liquor or drugs during working hours,
13. avoiding gossiping, horseplay during working hours,
14. reporting of near miss incident, accident, dangerous occurrence and occupational disease,
15. maintaining proper housekeeping,
16. undergo medical examination as required by the authority,
17. active participation and cooperation in safety management system,
18. intimation of likelihood of imminent danger to their lives or health due to any accident, to the occupier, manager or any other who is in-charge of the factory directly or through their representatives in the safety committee.

## CHAPTER 5: OBLIGATION OF EMPLOYEE

1. No employee shall spit within the premises of the factory except in the spittoons provided for the purpose.
2. Every employee required by the competent person who is appointed by the state govt. to enquire into the causes of any accident occurring in the factory or into any disease specified in the 3rd schedule of the Factories Act, 1948, has been, or is suspected to have been, contracted in a factory, for the purposes of making the inquiry to furnish any information shall be deemed to be legally bound.
3. No employee shall willfully interfere with or misuse any appliance, convenience or other thing provided in a factory for the purposes of securing the health, safety or welfare of the workers therein.
4. No employee shall willfully and without reasonable cause do anything likely to endanger himself or other.
5. No employee shall willfully neglect to make use of any appliance or other thing provided in the factory for the purpose of securing the health or safety of the workers therein.

## CHAPTER 6: RESPONSIBILITIES OF CONTRACTOR

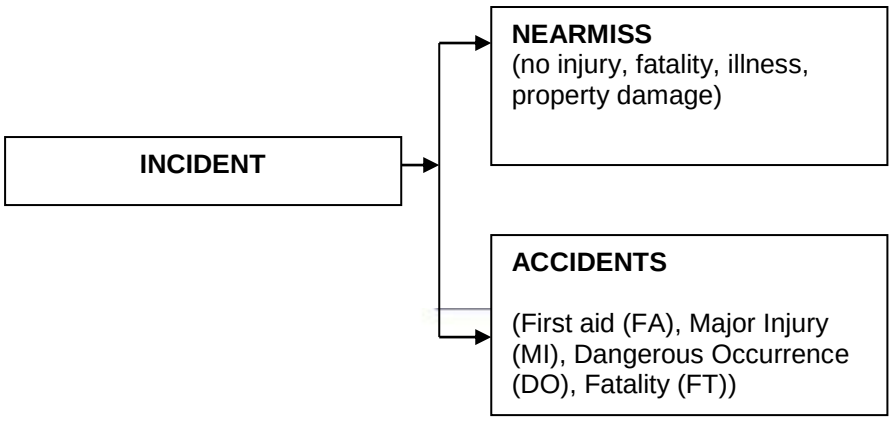
1. The contractor shall observe the safety provisions incorporated in the contract document and in case of sub-contract, it shall be the responsibility of main contractor that all safety requirements are followed by the employees and staff of the sub-contractor during execution of contract.
2. The contractor shall be responsible for non-compliance of the safety measures, implications, injuries, fatalities and compensation arising out of such situations or incidents.
3. In case of any accident, the contractor shall immediately submit a statement of the same to the in-charge of the work and safety officer, containing the details of the accident, any injury or casualties, extent of property damage and remedial action taken to prevent recurrence.
4. The Contractor shall have a Safety Plan detailing the safety norms that he shall evolve and also have a well-defined Safety & Health Policy.
5. The contractor shall be responsible for providing supervision of any work under his control to ensure compliance with the legal provisions.
6. The contractor shall take all the necessary measures to prevent accidents.
7. The contractor shall not allow any worker to work in an unsafe condition.
8. The contractor shall provide suitable and appropriate tools and equipment to the worker to perform the work.
9. The contractor shall provide adequate and suitable Personal Protective Equipments (PPEs) and fall arrestors.
10. The Contractor shall take sufficient measures so that workers under his control are safe at workplace.
11. Necessary license holder workers such as blaster, wireman, lineman etc., shall be engaged for the work.
12. The Contractor shall provide safety training to all his workers.
13. The Contractor shall be solely responsible for carrying out all activities in their scope while complying with the requirements of site safety plan, maintaining safe and healthy work conditions, and preventing environmental impacts.
14. Overall responsibility for the safety performance of contractor personnel will rest with the contractor's Site in- charge.
15. The Contractor will be required to keep all records and documentation required to comply with local regulatory requirements and site safety plan, on site, and available for review by NEEPCO Management.

16. The Contractor will co-operate with instructions from safety officer, where these require correction of identified non-compliance with regulatory requirement or this plan. The Contractor shall assign qualified supervision and competent persons to perform work, as required by applicable law and these instructions.
17. The Contractor shall provide employees with the training and orientation necessary to enable them to perform work assignments in a safe manner. All safety orientation and training conducted shall be documented and made available upon request.
18. The contractor employing two hundred employees or more, including contract workers, shall have a safety coordinator in order to ensure the implementation of safety requirements of the contract and a contractor with lesser number of employees, including contract workers, shall nominate one of his employees to act as safety coordinator who shall liaise with the safety officer on matters relating to safety and his name shall be displayed on the notice board at a prominent place at the work site.
19. Weekly Safety Meetings shall be held by the Contractor Site in-charge with all supervisors to coordinate related activities among craft/subcontractor and facilitate EHS training. Each Contractor Supervisor shall hold at minimum one weekly Tool Box talk with their crew. Topics discussed shall be pertinent to the work being performed and workers shall have the opportunity to ask questions regarding safety. All attendees shall sign the attendance record so that documentation reflects attendees and topics discussed. Records shall be kept at the project.
20. The Contractor shall inspect their work areas daily for hazardous conditions and environmental risks and take required corrective actions immediately. The Contractor's Safety coordinator shall conduct a documented weekly inspection of the Contractor's work areas. Audits/Inspections findings will be reported to the Contractor Site in-charge for corrective actions to be tracked to closure. The Contractor Site in-charge will be responsible for providing prompt corrective measures to eliminate any and all unsafe acts/conditions as they are reported.

## CHAPTER 7: REPORTING OF INCIDENT

**INCIDENT**: An *unplanned, undesired* event that hinders completion of a task and may cause injury, illness, or property damage or some combination of all three in varying degrees from minor to catastrophic.

**NEARMISS Incident**: - It is an incident in which no property was damaged and no personal injury was sustained, but where, given a slight shift in time or position, damage or injury easily could have occurred.




**ACCIDENT: -** It is defined as an unplanned event that results in personal injury or property damage

**FIRST AID ACCIDENT:** An accident which causes bodily injury and the gravity of injury is so small that the injured person resumes the work within 48 hours after the accident.

**Major Injury Accident (MI):-** an accident which causes bodily injury by reason of which it will prevent or will probably prevent the person injured from working for a period of 48 hours immediately following the accident.

**Fatality Accident (FT):-** an accident which results in death(s).

### Reporting of Accident & Nearmiss:

**Any nearmiss or injury at work—no matter how small—must be reported immediately to seniors.**

First report of injury – Any time a worker is sent to a physician for treatment of a work-related injury, a copy of the First report of Injury shall be sent to the Safety officer /site SHE representative (Safety Coordinator (in case of contractor). The Safety Officer shall enquire about the same and document the reason of injury.

Lost time Injury Report- Any time a worker is injured on the job and losses time from work beyond the date of the injury, a Lost Time Injury Report must be completed and sent to the Safety Officer. The Safety officer then shall inform the Unit Head / Chief Safety Officer about the last time injury report. The Chief Safety Officer / Unit Head will take further action on the matter.

A first aid log book shall be maintained at the Unit. Every injury or illness reported, no matter how small must be recorded. Entries shall be made promptly following treatment.

For employees, requiring, medical treatment from a physician, hospital or clinic off the job site, must be sent to the Attending physician to receive treatment. Site in charges are responsible for ensuring that this form is

properly completed. When a worker returns from the physician, hospital, or clinic, the worker must present the completed Clinic Referral Form for being allowed to return to work.

All accidents involving personal injuries/ illness (first aid and recordable), spills of oil/ hazardous materials, fires, explosions, serious near misses or property damage shall be immediately reported verbally to the Chief Safety Officer at Corporate Office, Technical Wing Head and the Unit Head. A written notification of the accident / incident will be provided within 24 hours of the accident / incident to the local authority / NEEPCO Corporate Office by the concerned Safety Officer.

The Safety Officer / Asst. Safety Officer of the Unit will be responsible for ensuring all required internal & external reporting obligations which are required to be met including monthly / annual reporting of site safety status / returns to the Chief Safety Officer.

**A. Reporting by contractor:**

Any accidents whether involving occupational injury (first aid and recordable)/ fatality or not, spills of oil/hazardous materials or property damage shall be immediately reported verbally by the contractor to the site in-charge and the safety officer. The contractor shall complete and forward a monthly summary of the same related to his employees and employees of his sub-contractors to the site in-charge no later than three calendar days following the end of each month.

**B. Internal reporting by project/plant/offices:**

a) Any accidents whether involving occupational injury or not shall be reported to the I/C (S&S) by the project/plant/office authority on monthly basis in the prescribed format in Annexure-I (A).
If any near-miss incident occurs, shall also be reported to the I/C (S&S) by the project/plant/office authority on monthly basis in the prescribed format in Annexure-I (B).

b) If any fatal accident occurs, report shall be sent by Head of Plant/Head of Project/ manager of the factory/ engineer in-charge immediately on Telephone/Fax to GM(Tech) to CMD and also to I/C (S&S) on priority. While sending the said report, copy shall be send to D(T) & D(P). **(O/O no.-67 issued under memo no. CMD/Estt/6/200/552-81 dated the 29th July, 2005)**

**C. External reporting by project/plant/offices to the statutory authority:**

If any accident occurs which causes death or any bodily injury by reason of which the person injured is prevented from working for a period of forty-eight hours or more, the Head of Plant/ Head of Project/ manager of the factory/ engineer in-charge shall send notice in the prescribed format and within the time limit as specified in respective acts and rules to the concerned authorities, according to the type/cause of accident. The copy of the same shall be forwarded to I/C (S&S) for further necessary action and record.

## CHAPTER 8: REPORTING OF DANGEROUS OCCURRENCE

**Dangerous Occurrence (DO):-** an accident which causes any bodily injury or disability or not or can cause property damage which results sufficient fiscal loss. Following are some of the examples of dangerous occurrence for better understanding:

(a) Bursting of a vessel used for containing steam under pressure greater than atmospheric pressure, other than plant which comes within the scope of the Indian Boilers Act.
(b) Collapse or failure of a crane, derrick, winch, lift, hoist or other appliances used in raising or lowering persons or goods, or any part thereof, or the overturning of a crane.
(c) Explosion, fire, bursting out, leakage or escape of any molten metal, hot liquor, or gas causing bodily injury to any person or damage to any part or portion of the factory in which persons are employed or damage to any plant, machinery or material
(d) Explosion of a receiver or container used in any process, or used for storage at a pressure greater than atmospheric pressure, of any gas or any gases (including air) or any liquid or any solid.
(e) Collapse or subsidence of any floor, gallery, roof, bridge, tunnel, chimney, wall or building forming part of a factory or workplace or within the compound or curtilage of factory etc.

### A. Internal reporting by project/plant/offices:

If any dangerous occurrence occurs, it shall be reported by the project/plant authority to the I/C (S&S) on monthly basis in the prescribed format in Annexure-I (C).

### B. External reporting by project/plant/offices to the statutory authority:

If any dangerous occurrence occurs, whether causing any bodily injury or disability or not, the Head of Project/Head of Plant/ manager of the factory / engineer in-charge shall send notice in a prescribed format and within the time limit as specified in respective acts and rules to the concerned authorities, according to the type/cause of dangerous occurrence. The copy of the same shall be forwarded to I/C (S&S) for further necessary action and record.

## CHAPTER 9: REPORTING OF OCCUPATIONAL DISEASE

If any disease as specified in the 3rd schedule of the Factories Act, 1948, occurs, the Head of Project/Head of Plant/ manager of the factory / engineer in-charge shall send notice in a prescribed format and within the time limit to the authorities, as specified in the state factories rules. The copy of the same shall be forwarded to I/C (S&S) for further necessary action and record.

## CHAPTER 10: RECORD KEEPING OF ACCIDENT, DANGEROUS OCCURRENCE AND OCCUPATIONAL DISEASE

### A. Accident and dangerous occurrence:

The safety officer shall maintain record of near miss incident, accident and dangerous occurrence. He shall also maintain the statistics like incident rate, frequency rate, severity rate etc.

### B. Occupational disease:

In case of occupational disease, record shall be maintained by the factory medical officer.

All the incident reports, investigation reports corrective actions identified by the accident investigation team will be documented & kept in files by the Safety Officer. Safety Corrective Action reports (CAR) be issued following completion of the accident investigation. Documentation of completed corrective actions will be maintained in the site Safety files by the Safety Officer.

## CHAPTER 11: INVESTIGATION OF ACCIDENT/ DANGEROUS OCCURRENCE / OCCUPATIONAL DISEASE

The aim of the investigation shall be fact finding to avoid recurrence in future. The investigation report shall be submitted to the Head of Plant/project for necessary action.

### A. Accident or dangerous occurrence:

The safety officer shall carry out investigation of nearmiss incident, accident and dangerous occurrence as early as possible to find out the root cause.

### B. Occupational disease:

In case of occupational disease, investigation shall be carried out by the factory medical officer.

### C. Investigation by special committee:

If management feels necessary, a special investigation committee shall be constituted with multidisciplinary technical expert.

**Preliminary Enquiry / Investigation:-**

All accidents resulting in fires, explosions, oil / hazardous material spills, injuries to the employees, near miss incidents at Units shall be investigated and reported to the Chief Safety officer at Corporate Office. All other accidents including injuries (accidents involving company vehicles, property damage and significant near

misses and hazards), shall be reported to the Unit Head immediately & the Chief Safety Officer within 72 hours of occurrence of the incident.

All accidents shall be investigated and documented using the Accident Investigation Reporting Procedure. The Safety Officer conducts preliminary investigation in all cases. The accident investigations must be initiated as soon as possible after the accident occurs and not later than 24 hours after the accident. The Preliminary Accident Investigation Report will be forwarded to the Unit Head and the Chief Safety Officer at Corporate Office for further analysis & future actions.

**Final Investigation Report:-**

The Chief Safety Officer, if not satisfied with the Preliminary Investigation Report shall initiate action for further investigation involving officers from other Units / Corporate Office: After receipt of Final Investigation Report, he shall place the reports before MD / CMD for remedial actions basing on the recommendations.

The findings of the investigation on the cause of the accident and corrective action to be taken will be communicated to site personnel through postings, in the Notice Board, discussion during SHE meeting or tool box talks. The anonymity of personnel involved in the accident or who provided information during the investigation will be secretly maintained.

**PROCEDURE FOR INCIDENT INVESTIGATION:**

1. Requirement of incident Investigation

Root cause analysis of incidents is needed for the following reasons:

- Preventing future incidents / accidents
- Reducing risks to acceptable limit
- Identifying and correcting / eliminating unsafe conditions, acts or procedures
- Reducing costs and downtime
- Meeting regulatory requirements, if any
- For facilitating insurance claims

Accident investigation is hindsight and helps learn from the mistakes. It is an opportunity to change the working environment by correcting unsafe acts, conditions or procedures.

2. Aim of Investigation

An investigation should, as far as possible, aim at –

- To prevent injuries, loss of life, health, property damage, environment,
- To determine the cause(s) of the incident;
- To identify unsafe conditions,
- To identify unsafe acts or inadequacy procedures or lacunas in system which contributed in any manner to the incident; &
- Recommending corrective actions to prevent recurrence of similar incidents.

3. Investigation Team

Nearmisses, First aid cases shall be investigated by safety officer(s) with an engineer nominated by concern departmental head.

Major accidents, dangerous occurrence, fatality should be investigated by a team nominated by the top management (Occupier / plant head / factory manager). The management should form the investigation team of three to four expert members. The team should have a representative of safety department and other expert members should be from different technical background such as mechanical, electrical, civil, chemical, fire. Person from the same department where accident occurred or the department whose employees are involved should not be included in the investigation team to avoid the conflict of interest. The team members should be trained in the investigative techniques and should be conversant with the work being performed at the incident site. The investigators should focus on the system flaws (and not the individuals) and the underlying or root causes (and not apportioning blame).

Investigators should pursue following basic principles of effective incident investigation:

(1) Deployment of only trained investigators
(2) Belief that almost all incidents (or at least their outcomes) are preventable
(3) Application of proper investigative techniques
(4) Focusing on the management system flaws or failures that led to the accident/incident
(5) Aiming at the identification of underlying or root causes

4. Investigation Procedure

The outline of the investigation procedure is as follows:

- Keep the accident/incident scene as undisturbed as possible
- Make accurate record of the scene (photos, drawings, measurements)
- Conduct interviews (witnesses, others)
- Evaluate evidence, draw conclusions
- Write report with recommendations
- Action plan
- Implementation and follow-up.

The investigators should follow Accident Investigation Procedure in the following sequence:

1. Gather information
2. Collect evidence
3. Interview eyewitnesses
4. Interview any other person who can provide the required information
5. Check documents and records
6. Analyse the information
7. Reconstruct the accident or incident.

5. What to be Determined Investigators should determine the following:

- Who was involved / injured?

- Where did the incident occur?
- When did accident occur?
- What were immediate and basic causes?
- Why was unsafe act/condition permitted?
- How can similar incidents can be prevented in future?

It may sometimes be appropriate to obtain background information before visiting the accident site. For example:

- General procedures for the type of operation involved
- Records of instructions/briefings given on the particular job being investigation
- Command structures and persons involved.

The accident causes related managerial or organizational aspects should be considered. To collect the relevant information, the investigators should seek answers to the questions like:

- Had the hazards been previously identified?
- Were hazards eliminated or adequately controlled?
- Had procedures been developed to address them?
- Were the workers competent for the job? Did they have adequate knowledge, skills and experience?
- Were work procedures available? Were they followed?
- Was there proper supervision?
- Was appropriate PPE available? Was it used? …and so on.

6. Time frame

Investigate all incidents, including near-miss incidents. Investigation should be carried out as soon as possible after the accident/incident. The quality of evidence can deteriorate rapidly with time, and delayed investigations are usually not as conclusive as those performed promptly. Investigation should aim at identifying root causes so as to find effective solutions. Remember, near-miss incidents are free lessons to us, so they must be investigated.
Though certain accidents (reportable) and dangerous occurrences need to be reported to Govt. authorities within a specified time period. There seems to be no legal requirement for the company management to investigate an incident. But the authorities may investigate any accident or dangerous occurrence and give recommendations. The investigators should focus on causes, not the blame. This allows management and supervisors to consider failures in the management system (company's basic operating procedures and management/supervisors attitudes) as the real cause of the accident, rather to simply blame the "careless worker". Management's goal should be to minimize consequences of mistakes or unsafe acts and have a mitigation plan.

7. Kit for facilitating proper investigation
   1. Camera
   2. Measuring tape
   3. Clipboard, writing-pad
   4. Pens, pencils
   5. A.I. (accident investigation) form
   6. Checklist
   7. Flashlight (flameproof)

8. Analysis of Investigation Findings

After collection of evidences and required information, the investigators should analyse the findings. The purpose of analysis is to establish the sequence of critical events and underlying causes of the accident and of the consequences. They should begin with the proximate cause and work backwards from there to get to the root causes.

- Equipment failure?
- Unsafe behaviour?
- Unsafe procedure?
- (Focus on the management systems.)

Now the investigators should find the remedies to avoid recurrence of similar accident or incident. This may require them to identify the following:

- Factors, which, if modified, would eliminate the unsafe behaviour
- Unsafe behaviour not corrected in the past, as supervisors are indifferent or not adequately trained to correct the same.

9. Recommendations

The investigators should ask the following three questions, when considering the contributory factors of an incident.

1. What can management do to prevent the incident from recurring?
2. What can the supervisor do to prevent recurrence?
3. What can the workers do to prevent recurrence?

After the investigation is over, the investigation team should prepare recommendations for the corrective actions. While doing this, care should be taken that the recommendations do not cause:

- Introduction of new hazards / risk
- Legal violations
- Violation of company safety policy.

Once this has been done, the investigation report may be prepared and submitted to the management.

10. Common Errors and Pitfalls

Investigators should be aware of common errors and pitfalls and avoid them. Major ones are listed below.

- Believing carelessness is a cause of accidents
- Assuming contradictory information indicates falsehood
- Conducting interviews as if in a courtroom
- Tendency to blame someone
- Looking for only one basic cause

11. Distribution of the Investigation Report Copies of accident/incident investigation report should be marked as “Confidential” and forwarded without undue delay to the concerned officers or departments.

12. Follow-up Action

Management should initiate corrective action without undue delay to prevent recurrence of similar incidents. The CAPA (Corrective Action Preventive Action) should be prepared for each incident with remedial actions, target date, responsible person etc as follows:

| Sr no | Remedial actions | Target date | Responsible person | Status (Closed / open) | Remark |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3<br>.<br>.<br>. | | | | | |

After the implementation of the recommendations, there should be a review and a report of the corrective actions taken should be sent to the Top Management and the Safety Committee. A further review may be carried out after a certain period (atleast once in 2 months) to know the effectiveness of the recommendations. It is the responsibility of the responsible person mentioned in the CAPA that remedial measures are completed within target dates and they should send the compliance report to the management for updating the status of remedial actions.

It must be remembered that those who do not learn from their mistakes are bound to repeat them. Incident investigation helps us to learn from our mistakes and improve safety.

All recommendations mentioned in the CAPA closed after that the investigation report shall be closed.

In case of nearmiss and first aid cases, PART 1, 2, 3, 4, and 5 of accident investigation form should be filled by safety officer and the details required for PART 4 shall be given by the concern departmental head.

In case of Major injuries, Dangerous occurrence and fatality cases, investigating team shall fill PART 1, 2, 3, 4, 5 of the accident investigation form and PART 4 the details required for PART 4 shall be given by the concern departmental head. The investigating team and HOP / Occupier / plant head shall close the report after the compliance.

## CHAPTER 12: SAFETY ORIENTATION, TRAINING AND PROMOTION

Adequate training/orientation shall be provided to all workers regarding safe working procedure and standard operating procedure of the work. The Human Resource Wing shall arrange all such training programme including safety. The Safety Officer shall be the key person coordinator for conducting safety awareness programme for motivation and promotion of safety and for the Human resource Wing will provide all necessary facilities such as safety training hall, seating arrangements, multimedia facilities such as projector, computer, mike, speakers, audio-visual arrangement for showing videos etc.

Each employee and workers shall undergo safety induction training program for minimum 2 days and one day respectively. For safety induction training a training module should be prepared. Induction training should also include briefing of company, existing hazards, safety rules to be followed in the company, safety policy, emergency response plan etc.

The safety department should prepare monthly / quarterly / yearly safety training calendar and should be submitted to Human Resource Wing.

Each employee and worker should undergo atleast 8 hours of safety training every year and it is the responsibility of Human Resource Wing to ensure that each employee and worker is undergoing atleast 8 hours of safety training every year and Human Resource Wing should arrange the participants as per the safety training calendar submitted by safety department and Human Resource wing should coordinate with participants and their concern departmental heads to release the participants during the training schedule. The employees and workers should attend the scheduled safety trainings failing to which disciplinary actions will be taken by the management of NEEPCO.

The following shall be included in the orientation program: Project safety rules, general safety awareness, first aid, Electrical safety, Manual and mechanical Material handling, Ergonomics, Use of MSDS (Material Safety Data Sheet) and Safe handling of chemicals, Accident prevention, Nearmiss, SOPs, Personal protective equipment (its selection, use, maintenance and store), Emergency response plan, Housekeeping (including 5 S system), Hazard Identification and Evaluation (HIRA / JSA), Work permit system, Defensive driving, Fire prevention and protection system, Basic fire fighting, Case study sharing, Safety in machine and guarding, Accident Investigation & Analysis, Role of Safety Officers / Coordinators, Safety Audit / Inspections, Safety in Working at Heights, Office Safety, Statutory Requirement pertaining to Occupational Safety and Health, emergency procedures including shock treatment, use of personal protective equipment, safety precautions while handling electro-mechanical equipment, use of different types of firefighting equipment, response in the event of emergencies including fire, flood, landslide, earthquake etc; site specific hazards and the precautions as well as response in respect of the same. All training presentations or module should be reviewed and revised as per current scenario or updation periodically (atleast once in 3 years) by the safety department.

Every safety officer shall have to undergo safety training conducted by the National Safety Council of India, Bombay, Director General- Factory Advice Service and Central Labour Institute, Bombay and, from time to time to make him sufficiently expert.

Safety promotional activities shall be organized periodically to create awareness and enthusiasm among the employees which shall include organizing safety day, safety week, safety competitions and display of posters, banners, safety calendars and displays depicting possible consequences of unsafe acts and conditions in conspicuous locations in the plant. Safety literature item shall be displayed and distributed for awareness and promotion of safety.

**NSW** (National Safety Week – 4th - 10th March): Every year each plant should celebrate National Safety Week during 4-10 March. During this celebration following activities should be performed for employee and workers: safety exhibition, safety quiz competition, poster competition, essay competition, training programs, prize distribution to winners of competitions etc.

**RSW** (Road Safety Week – 11th -17th January): Every year each plant should celebrate Road Safety Week during 11-17 January. During this celebration following activities should be performed for employee and workers: quiz competition, poster competition, Defensive training programs, prize distribution to winners of competitions etc.

**WED** (World Environment Day - 5th June): Every year each plant should celebrate World Environment Day on 5th June. During this celebration following activities should be performed for employee and workers: Tree Plantation, quiz competition, poster competition etc. This initiative should be conducted by Environment wing.

**FSW** (Fire Service Week – 14th – 20th April): Every year each plant should celebrate Fire Service Week during 14 – 20th April. During this celebration following activities should be performed for employee and workers: Fire Fighting drill / Demo, quiz competition, poster competition, Fire safety exhibition, training sessions of fire safety etc.

For promotion of safety signages, posters, slogans should be displayed at strategic location and as far as possible all promotional materials should be in pictorial form and in local language for better understanding of employees and workers.

All activities and statistics of safety trainings and promotion should be communicate to corporate Human Resource wing and corporate safety department by the individual plant Human Resource wing for monitoring purpose.

## CHAPTER 13: HAZARD IDENTIFICATION, RISK ASSESSMENT AND MANAGEMENT

The Safety Officer in close coordination with Risk officer shall identify the inherent hazard related to the works of the plant/project and assess the risk associated with the hazard. He shall assist the management in managing the risk.
For each phase of the work a Job Safety Analysis /Risk Assessment shall be developed. The analysis shall be job specific and shall include all major tasks, sequence of work. This shall include health and safety hazards related to chemical, physical, and ergonomic stress. For jobs involving the physical or use of chemicals, control measures such as engineering, administrative or PPE must be identified and included in the job safety analysis and reviewed with personnel prior to starting work. Control measure or precautionary actions include requirement of particular PPE, fall protection measures, fire protection measures, barricades, safe work practices etc. The completed Job Safety Analysis and Risk Assessment shall be submitted to the Site engineer/site in-charge/Er. In-charge for necessary risk management. The Job Safety Analysis shall be updated whenever there are significant changes in the work plan, materials used, work environment, or a new crew or subcontractor is assigned to conduct the work.

In case of imminent danger, the Site Engineer/Site in-charge/Er. In- charge shall immediately prohibit site personnel from working in the affected area until the hazard has been corrected.

Material Safety Data Sheet (MSDS) for each hazardous material used in the plant/project shall be displayed near to the hazardous material in the local languages or languages spoken by majority of the employees working at the site.

## CHAPTER 14: SAFETY INSPECTIONS AND AUDITS

### A. Safety inspection:

The purpose of a safety inspection is identify risks / hazards in the plant and highlight to the management the deficiency / lacunas in the safety management system and target specific operational, facility, or program deficiencies that may cause accidents, injuries, and illnesses, and to foster compliance with Rules and standards and rectifying the unsafe conditions and act with proper action plan with timeframe and responsibilities to achieve “ZERO ACCIDENT”.

1. Safety Officer/ his assistants shall carry out Plant safety Inspections on a day to day basis and evaluate hazards of the work environment. Industrial safety inspection shall be carried out by the Safety Officer. It

must be ensured that all plant areas including remote areas of the unit are covered at least once a month. If an imminent danger is identified, the Safety Officer must immediately inform the official in charge of the workplace and stop the work till the unsafe condition / act is corrected

2. Each departmental head shall inspect the area under his jurisdiction on a weekly basis for safety and take immediate steps to correct any deficiency.
3. Occupational health and medical facilities inspection shall be carried out by the Factory Medical Officer.
4. Safety committee may shall also conduct safety and occupational health inspection for whole plant atleast once in a quarter.
5. Housekeeping survey / inspection shall be conducted by safety officer and Head of department or representatives of HOP individually atleast once in a month.
6. Inspection of all portable electrical tools such as welding machine, grinding machine, cutting machine etc. shall be conducted by electrical Engineer atleast once in a fortnight and provided tag indicating whether it is safe to use or not and shall also indicate date of inspection and due date of inspection.
7. Safety Inspection of mechanical machines, gas cylinders etc. should be conducted by concern department.

They must use inspection checklists prepared for the purpose for the area on a plant by plant basis. All observations should be noted down in the Safety Inspection register (Log Book). Reports for improvement should be raised to the concerned department based on this record.

The non-compliance / areas for improvement observed during all safety inspections shall be rectified with CAPA (Corrective Action and Preventive Actions) with responsibilities and time frame. The official in charge of the workplace must undertake immediate corrective measures to mitigate the dangerous condition. The concern departmental head shall ensure that all non-compliances / unsafe conditions / acts are rectified within given timeframe. The compliance report of CAPA shall be sent to safety department by the concern departmental head for monitoring and the same should be sent to the occupier/manager of the factory/ head of plant / head of project.

**B. SAFETY AUDIT:**

**a) Internal audit**:

Internal safety audit shall be conducted by a cross functional team appointed by the Occupier / manager of the factory/ head of plant / head of project and the team members shall consisting of atleast 3 members including safety officer. The other team members shall be of experienced senior executives / department heads of mechanical, electrical, civil etc. Internal Safety Audit shall be conducted once in six months for O & M units and once in 3 months for projects under construction. The audit shall be conducted based on IS 14489:1998 and other relevant acts and rules and Indian / international standards. For doing internal safety audit a suitable check list developed for the O & M plant and construction site.

The audit findings report shall be submitted to the Occupier / manager of the factory/ head of plant / head of project. The management shall prepare CAPA for rectifying Findings of audits with responsibilities and time frame. The concern departmental head shall be accountable to comply all recommendations and shall submit compliance report to the management for closing.

**b) Corporate audit:**

Corporate audit shall be conducted by a team appointed by I/C (S&S) at least once 12 months for O&M plants and once in 6 months for projects under construction. A team of Safety Officers from different plant/project

shall be appointed to carry out the Corporate Safety Audit. The report of the audit shall be submitted to I/C (S&S), who will review the report and seek compliance report of all pending issues within a stipulated period. The audit shall be conducted based on IS 14489:1998 and other relevant acts and rules and Indian / international standards and a suitable check list shall be developed for the same. The Corporate safety audit should also review compliance of the previous internal/ corporate/ external audit recommendations.

On the basis of corporate safety audit, the best O&M plant / project site shall be awarded every year.

**c) Intra NEEPCO Safety Audit**

Intra NEEPCO Safety audit shall be conducted by a team appointed by I/C (S&S) at least once 12 months for O&M plants and once in 6 months for projects under construction. The team of Safety Officers and experts (in mechanical, electrical, civil, chemical) from different plant/project of NEEPCO shall be appointed to carry out the Intra NEEPCO Safety Audit. The report of the audit shall be submitted to I/C (S&S), who will review the report and seek compliance report of all pending issues within a stipulated period. The audit shall be conducted based on IS 14489:1998 and other relevant acts and rules and Indian / international standards and a suitable check list shall be developed for the same. The Corporate safety audit should also review compliance of the previous internal / corporate / external audit recommendations.

**d) External audit**:

External audit shall be carried out by competent professional organizations such as National Safety Council of India, Navi Mumbai, Director General of Factory Advice Service and Labour Institute (DGFASLI). External audit for the project under construction and erection stage shall be carried out at least once in every year and for units under operation stage it shall be carried out at least once in every two years.

The management shall prepare CAPA for rectifying recommendations of external safety audits with responsibilities and time frame. The concern departmental head shall be accountable to comply all recommendations within timeframe and shall submit compliance report to the management for closing.

## CHAPTER 15: SAFE WORK ENVIRONMENT

### A. Illumination and emergency lighting:

1. Sufficient illumination as per relevant national standards shall be arranged for maintaining safe working conditions at workplace and for passageways, stairways and landings, excavation site, tunneling work.
2. Emergency generators shall be provided and is readily available for service at all times to ensure adequate illumination at all workplaces where work is being carried out at night and dark places, in case of power failure.
3. Such emergency power supply system shall be capable of operating air compressor and ancillary systems of such compressed air system.

### B. Noise pollution:

1. Noise survey shall be carried out atleast once in 12 months by safety department and List the High noise level areas and this list shall be forwarded to OHC and HR wing.

The HR wing shall send the list of employees and workers working in the High noise level areas to OHC incharge. OHC incharge and HR wing shall ensure that atleast employees and workers working in high noise level areas shall undergo audiometry test during pre-employment and periodical audiometry test atleast once in 12 months.

Effective engineering control and administrative measures shall be taken to reduce the high noise level Below 85 dBA (90 dBA or more).

2. High noise level area shall be marked and displayed.

3. Proper earplug/earmuff shall be provided by concern department and ensure that employees and workers are using it used at the high noise area to protect the worker from the exposure of high noise.


4. Exposure in excess of 115 dBA shall not be permitted at any case.

**C. Harmful gases, fumes and dust pollution:**

1. Workers shall not be allowed to enter any confined space such as chamber, tank, pit, pipe etc. where any harmful gas, fume, vapour or dust is likely to be present.
2. All necessary measures shall be taken to remove such harmful substances up to permissible limit from the confined space and shall be confirmed before entry of the worker to perform any work.
3. Effective artificial ventilation shall be provided to control the above hazard.
4. A certificate in writing shall be issued by the tester that the confined space is reasonably free from such dangerous and harmful substance and the tester shall use suitable breathing apparatus and a belt securely attached to a rope and free end of which is held by a person outside the confined space.
5. Welding, cutting, brazing or soldering shall not be allowed in any tank, vessel or any confined space which contains or has contained any explosive or inflammable substance unless adequate measures are taken to remove such harmful and dangerous substance.

**D. Ventilation:**

1. Artificial ventilation by mechanical means shall be arranged and provided at the workplaces where workers employed underground.
2. The amounts of fresh air supplied by mechanical means of ventilation in an hour shall be equivalent to at least six times the cubic capacity of the workroom and shall be distributed evenly throughout the workroom without dead air pockets or under draughts caused by high inlet velocities. The amount of fresh air to be provided shall be as per the relevant rules.
3. Exhaust fans, jets, ducts, hoods, etc. shall be so designed, constructed, maintained and operated as to ensure the required protection by maintaining a volume and velocity of exhaust air sufficient to gather

dusts, fumes, vapour or gases from said equipment or process, and to convey them to suitable points of safe disposal, thereby preventing their dispersion in harmful quantities into the atmosphere where employees work.

4. Ventilation system shall be provided with a back-up power supply source so that it continues to operate in the event of failure of regular power supply system.
5. The maximum permissible threshold limits of exposure of chemical and toxic substances in manufacturing processes (whether hazardous or otherwise) in any factory shall be of the value indicated in the 2nd Schedule of FA 1948.
6. Site incharge shall ensure at a construction site of that the operator of every lifting machine in is provided with a cab or cabin which is adequately ventilated.
7. The site incharge shall ensure at a construction site that all work areas in a free air tunnel are provided with ventilation system as approved by the Director General & the fresh air supplied in such tunnel is not less than 6 m3 / min for each building worker employed underground in such tunnel and the free-air-flow movement inside such tunnel is not less than 9 m/min.
8. The precautions shall be taken to prevent inhalation of dust, fumes, gases or vapours during any grinding, cleaning, spraying or manipulation of any material & steps shall be taken to secure & maintain adequate ventilation of every working place or confined place.
9. No person shall be allowed to enter any chamber, tank, vat, pit, pipe, flue or other confined space in factory in which any gas, fume, vapour or dust is likely to be present to such an extent as to involve risk to persons being overcome thereby, unless it is provided with a manhole of adequate size or other effective means of egress.
10. No person shall be allowed to enter any confined space until all practicable measures have been taken to remove any gas, fume, vapour or dust, which may be present so as to bring its level within the permissible limits and to prevent any ingress of such gas, fume, vapour or dust and unless- a certificate (Work permit) in writing has been given by a experienced person, based on a test carried out by himself that the space is reasonably free from dangerous gas, fume, vapour or dust.

## CHAPTER 16: HOUSEKEEPING

Housekeeping shall be systematic, comprehensive and consistent with the requirement of applicable Safety Rules. Workmen are frequently injured by tripping, stumbling, stepping on or bumping into tools, material and other objects left lying around or by carelessly placed objects falling from above.

Housekeeping means "EVERYTHING SHALL HAVE DESIGNATED PLACE AND EVERYTHING SHALL BE IN ITS DESIGNATED PLACE". Hence Housekeeping shall not be limited to only just cleaning the area. It is a combination of orderliness and cleanliness. It is a part of everyday life and plays a significant role in preventing accidents. Orderliness and cleanliness can be achieved only if;

- All things have an assigned place for storage.
- All things are kept in their assigned place
- Storage of materials are done in an orderly and neat manner
- Unwanted things are not kept around.
- Sources of uncleanliness are arrested, and
- Sources contributing to uncleanliness are removed and disposed off safely.

The state of cleanliness of a plant cannot be achieved by an occasional grand cleanup during an annual inspection or housekeeping drive. It requires sustained efforts and cooperation of all employees working in the

plant. The active support and encouragement of the plant management is a must. A well kept plant is indicative of a safe place to work at and indicate competent management and an efficient workforce.

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping accidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous dusts and vapors

better control of tools and materials, including inventory and supplies

- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- pleasing appearance to the workplace resulting in improved morale of employees
- improved productivity

Housekeeping order is "maintained" not "achieved." Cleaning and organization must be done regularly, not just at the end of the shift. Integrating housekeeping into jobs can help ensure this is done. A good housekeeping program identifies and assigns responsibilities for the following:

- clean up during each shift
- timely disposal of waste
- removal of unused materials
- inspection to ensure cleanup is complete

**Housekeeping Program**

**1) Dust and Dirt Removal**

Regular cleaning of dust and dirt from work areas as well as equipment and removal of waste generated is an essential part of good housekeeping. Floors must be cleaned / mopped / vacuumed depending upon the type of area. Housekeeping of the area where any maintenance activity is carried out is essentially the duty of the crew carrying out the maintenance.

**2) Employee Facilities**

Employee facilities need to be adequate, clean and well maintained. Lockers are necessary for storing employees' personal belongings. Washroom facilities require cleaning once or more each shift. They also need to have a good supply of soap, towels plus disinfectants, if needed. Smoking, eating or drinking in the work area should be prohibited. The eating area should be separate from the work area and should be cleaned properly each shift.

**3) Surfaces**

Poor floor conditions are a leading cause of accidents so cleaning up spilled oil and other liquids at once is important. Allowing chips, shavings and dust to accumulate can also cause accidents. Trapping chips, shavings and dust before they reach the floor or cleaning them up regularly can prevent their accumulation. Areas that cannot be cleaned continuously, such as entrance ways, should have anti-slip flooring. Keeping floors in good order also means replacing any worn, ripped, or damaged flooring that poses a tripping hazard.

**4) Illumination**

Adequate lighting in work area is an essential component of good housekeeping. Dirty light fixtures reduce essential light levels. Clean light fixtures can improve lighting efficiency significantly. For adequacy of illumination in work area refer recommended illumination levels in the respective State Factories Rules. One can also refer IS 3646:1992 (Part-1) – 'Code of Practice for Interior Illumination'.

**5) Aisles and Stairways**

Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Keeping aisles and stairways clear is important. They should not be used for temporary "overflow" or "bottleneck" storage. Stairways and aisles also require adequate lighting.

**6) Spill Control**

The best way to control spills is to stop them before they happen. Trays shall be placed below drums/ cans containing liquid. Regularly cleaning and maintaining machines and equipment is one way. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills.

**7) Tools and Equipment**

Housekeeping of tools is very important, whether in the tool room, on the rack, in the yard, or on the bench. Tools require suitable fixtures with marked locations to provide orderly arrangement, both in the tool room and near the work bench. Tools should be returned promptly to the tool room after use to reduce the chance of being misplaced or lost. Workers should regularly inspect, clean and repair all tools and take any damaged or worn tools out of service.

**8) Fire Fighting and First Aid Equipment**

Firefighting equipment, first aid boxes and rescue items should be stored at prominent locations and the area should be marked. Access to the above should be free and other materials should not be stored near these so as to prevent it from being reached easily. A regular schedule needs to be maintained for the cleaning, testing and replenishment of these emergency items

**9) Waste Disposal**

The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities. Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing scrap containers near where the waste is produced encourages orderly waste disposal and makes collection easier. All waste receptacles should be clearly labeled.

**10) Storage**

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. All storage areas should be clearly marked.

## Housekeeping Committee & Housekeeping Competition

A house keeping committee shall be appointed by the Occupier of each unit consisting of departmental heads to conduct a house keeping visit of all plant areas. The team should prepare and use a suitable checklist for these visits. The frequency of these visits shall be at least once a month. The checklist should be such that observations can be converted to quantitative evaluation points.

A House keeping competition shall be conducted between areas of work / workshops on a yearly basis and a rolling trophy shall be instituted for the best maintained work area. Monthly points as obtained from the monthly housekeeping inspections shall be tabulated to arrive at the final winner of the Housekeeping Competition. The process shall be transparent and monthly points obtained by each work area may be displayed on the notice boards to instill a sense of healthy competition among employees.

To ensure good housekeeping, the following safety precautions shall be observed in construction / O & M activity as applicable:

1. Every workplace shall be kept clean and free from effluvia arising from any drain, privy or other nuisance.
2. Loose materials which are not required for use shall not be placed or left so as dangerously obstruct workplaces and passageways.
3. All projecting nails shall be removed or bent over to prevent injury.
4. Equipment, tools and small objects shall not be left lying unattended where they could cause an accident either by falling or causing a person to trip.
5. Scrap, waste and rubbish shall not be allowed to accumulate at the site.
6. Workspaces and passageways that are slippery owing to oil or other causes shall be cleaned up or strewn with sand, ash or suitable means.
7. Portable equipment shall be returned after use to its designated storage place.
8. Walks, aisles, stairways, fire escapes and all other passage ways shall be kept clear of all obstructions.
9. Tools and materials shall not be placed where they may cause tripping or stumbling hazards or where they may fall and strike any one below.
10. Puddles of oil and water create a slipping hazard. Spillage of oil or lubricant on the floor shall be immediately wiped out and strewn with sand, ash or the like. Slippery floor shall be marked with caution sign. Effective means of drainage shall be provided and maintained where a floor is liable to become wet due to manufacturing process or during maintenance of machineries.
11. Nails in boards, such as those removed from scaffolds, forms and packing boxes, constitute a hazard and shall be removed. The boards shall be carefully stacked or stored.
12. Dirty and oily waste rags shall be disposed-of as soon as practicable to avoid fire hazard.
13. All pathways shall be conspicuously marked.
14. All floor areas, pathways shall be even & free from pot holes, pits & humps.
15. Broken light bulbs, glass, metal scrap and other sharp objects shall be dumped in places, provided specially for them.
16. Discarded fluorescent and other gas filled tubes shall be disposed of safely.
17. Accumulations of dirt and refuse shall be removed daily by sweeping or by any other effective method from the floors and benches of workrooms and from staircases and passages, and disposed of in a suitable manner.
18. The floor of every workroom shall be cleaned at least once in every week by washing, using disinfectant, where necessary, or by some other effective method.
19. Effective means of drainage shall be provided and maintained where a floor is liable to become wet due to manufacturing process or during maintenance of machineries.
20. Spillage of oil or lubricant on the floor shall be immediately wiped out and strewn with sand, ash or the like.
21. Slippery floor shall be marked with caution sign.

22. Equipment, tools and small objects shall not be left lying unattended or unsecured from where they could fall or cause a person to trip.
23. All inside walls and partitions, all ceilings or tops of rooms and all walls, sides and tops of passages and staircases shall:
    (i) where they are painted otherwise than with washable water-paint or varnished, be repainted or re-varnished at least once in every period of five years;
    (ii) where they are painted with washable water paint, be repainted with at least one coat of such paint at least once in every period of three years and washed at least once in every period of six months;
    (iii) where they are painted or varnished or where they have smooth impervious surfaces, be cleaned at least once in every period of fourteen months by soap and brush.
24. In any other case, inside walls and partitions be kept whitewashed or colour washed, and the whitewashing or colour washing shall be carried out at least once in every period of fourteen months;
25. All doors and window frames and other wooden or metallic frame work and shutters shall be kept painted or varnished and the painting or varnishing shall be carried out at least once in every period of five years;
26. All floors, steps, stairs, passages and gangways shall be of sound construction and properly maintained and shall be kept free from obstructions and substances likely to cause persons to slip, and where it is necessary to ensure safety, steps, stairs, passages and gangways shall be provided with substantial handrails.

## CHAPTER 17: PREVENTION OF SLIPS, TRIPS AND FALLS

Slips, trips and falls are common causes of injuries at workplaces which can result in head injuries, back injuries, cuts lacerations, sprained muscles or even death. Most of these incidents can be prevented with general precautions and safety measures.

Slips happen where there is too little friction or traction between the footwear and the walking surface. Common causes of slips are wet or oily surfaces, smooth surfaces, inappropriate or wet footwear, leaks or spills, loose or unanchored rugs or mats, etc.

Trips happen when a person's foot inadvertently hits an object causing loss of balance and resulting in fall. Common causes of trips are obstructed view, poor lighting, uneven walking surfaces, thresholds and steps ( particularly a single step ), blind corners, obstacles on the walkway such as trailing cables, tools, trolleys, packing materials, drawn-out shelves, wrinkled/curled/loose carpeting, etc.

Fall occurs when one is too much off-balance. Common causes of falls are unprotected floor openings, working platforms and passages at height, unstable work platforms, improper use of ladder or scaffolding, unguarded edges of floors and landing of stairways, fragile roofs, unstable posture, etc. A fall can be at the same level or from a height to a lower level.

General precaution for prevention of slips, trips and falls:

1. Clean and mop up water and other spills immediately and display a "Caution Wet Floor" sign.
2. Modify work practices that cause spills.
3. Remove obstacles from walkways and always keep it free of clutter.
4. Avoid leaving objects on floor.
5. Provide adequate lighting in the work area.

6. Minimize changes of floor level. Provide ramp instead of steps when level changes is imminent.
7. Use high visibility fluorescent paint or tape to mark changes in floor levels.
8. Consider providing non-skid floors.
9. Look for and report broken/ loose tiles, worn out floor coverings and loose or frayed carpets and mats.
10. Ensure carpets are anchored or secured to avoid curled edges.
11. Position equipment so as to avoid trailing cables crossing pedestrian routes. Use securely fixed cable covers, if necessary.
12. Barricade floor openings.
13. Ensure stairs and work platforms at height have protective railings and toe boards.
14. Ensure the scaffolding is properly erected and used.
15. Use safety belt while working at height. If necessary, depending on the height of the scaffold, include a suitable fall protection system.
16. Ensure that ladders are sturdy, in good repair and during usage they are stable and secure.
17. Face the ladder while ascending or descending it.
18. Follow the three point contact principle. At any given time, two feet and one hand or two hands and one foot must be in contact with ladder.
19. Avoid carrying tools, materials, etc. in the hand while climbing a ladder. Use tool bag or belt.
20. Never overreach while working at an elevated level.
21. Never use makeshift devices like a chair in place of a stool, or using a ladder as platform.
22. Minimise carrying loads on stairs.
23. Wear non-skid footwear. Ensure footwear is free from grease, oil, mud, etc.
24. Be careful of wet shoes on a dry floor since they can be just as sleeper as a wet floor.

## CHAPTER 18: EMERGENCY PREPAREDNESS PLAN

A major emergency can be defined as an accident/ incident that have potential to cause serious injuries or loss of life. It may cause extensive damage of property, serious disruption both in production and working of factory and may adversely affect the environment. The following factors may cause major emergency: Plant failure, fire, bomb blast, collapse of structure, vehicle crash, sabotage, earthquake, natural calamities.

**A. On-site Emergency**:-

If an accident/ incident takes place in a factory, its effects are confined to the factory premises, involving only the persons working in the factory and the property inside the factory it is called as On-site Emergency.

**B. Off-site Emergency**:-

If the accident is such that it affects inside the factory are uncontrollable and it may spread outside the factory premises, it is called as Off-site Emergency.
The main objectives of an emergency plan are to control and contain the incident/ accident and if possible, eliminate it and to minimize the effects of the incident on person, property and environment.
Each major hazardous factory shall prepare an emergency plan incorporating details of action to be taken in case of any major accident/ disaster occurring inside the factory. As per the statutory requirement a disaster management plan (on-site emergency plan and off-site emergency plan) is to be prepared by the management and specific responsibilities are to be fixed to the persons as well as departments. The plan shall cover all types of major accident/ occurrences and identify the risk involved in the plant.

**C. Mock drill**:

Mock drills on the plan shall be carried out once in a quarter to make the plan foolproof and persons are made fully prepared to fight against any incident in the plant.

## CHAPTER 19: EMERGENCY ESCAPE ROUTES

Emergency escape routes shall be marked clearly and distinctly with arrow mark towards the route of escape so that it can be noticed from far distance and during black out of the plant. Ensure that the number of exit routes is adequate based on the number of employees, the size of the building, its occupancy, and the arrangement of the workplace. Ensure that exit routes meet width and height requirements. The width of exit routes must be sufficient to accommodate the maximum permitted occupant load of each floor served by the exit route. Doors used to access exit routes shall have side hinges and swing in the direction of travel. Exit routes that lead to an outside area shall have enough space for all occupants. Emergency alarm systems shall be installed and in operable condition. Exit routes must be free and unobstructed. Lighting arrangements at all escape routes shall sufficient enough to use them safely in an emergency. Independent power source, e.g. a generator or DC supply system shall be arranged in case the main electricity supply fails. Floodlighting, lighting towers etc. if used, it does not shine in people's faces along the escape route.

## CHAPTER 20: OCCUPATIONAL HEALTH & MEDICAL FACILITIES

The owner / occupier shall provide medical facilities:

(a) to prevent and control occupational diseases;
(b) to prevent and reduce disability;
(c) to provide immediate relief to accident victims.

### A. Medical examination:

- The medical officer shall carry out the pre-employment as well as periodical medical examination once in 12 months for workers and employees including colour vision tests and eye sight examination for all vehicle drivers, skilled workers, technicians, supervisors and crane operators annually once in 12 months for those who are less than forty-five years old and once in every six months for those who are more than forty-five years old and keep all records.

- Every canteen staff who handles foodstuffs should be medically examined by medical officer atleast once in 12 month and examination should be as per the State factories Rules.

- Workers employed for working at height works should undergo height pass test which should be conducted by medical practitioner

- Workers involved in areas or in Operations Involving High Noise Levels (above 85 dBA) should undergo audiometry Examination by a medical officer at least once in every 12 months.

- Workers working in dusty environment should be medically examined atleast once in 12 months to ensure healthiness of Lungs.

### B. Occupational health centre:

The occupational health centre or ambulance room shall be established as per the provision of factories rules. The occupational health centre shall be suitably equipped to manage medical emergencies. The nos. and qualification of medical officers should be as per the state factories rules.

The medical officer of occupational health center shall be involved in planning the emergency handling of large number of injured employees in the event such as fire, explosion, natural calamities and man-made disasters and all the equipment required for providing immediate relief to the injured during emergencies shall always be kept in readiness in occupational health center.

### C. Ambulance van:

The owner shall ensure that a fully equipped ambulance van is provided at the site for transportation of serious cases of accident or sickness to the hospital promptly and said ambulance van is maintained in good condition and equipped with necessary facility.

The ambulance van should be inspected daily by the driver with the help of checklist and the inspection record should be maintained. The dresser cum compounder or OHC incharge should also check the ambulance vans atleast once in a week with checklist and records should be maintained so that ambulance vans are always in well maintained condition.

**D. First-aid facilities:**

First aid refers to the emergency treatment given to a person suffering from an accident or sudden illness, until a doctor attends. First-aid box shall be maintained with medicines and other equipment as prescribed by the factories rules of the respective state.

There shall be atleast one first aid box / cupboards for every 150 workers or part thereof. There should be atleast 2 first aiders available in each shift for each first aid box and there shall be incharge of first aid box and he should do inspection of first aid boxes every week to see whether it is in replenished condition or not and he should coordinate with OHC to ensure that first aid box is always in replenished condition.

The list of first aiders along with their names, designation, contact nos. shall be displayed near each first aid boxes and at other strategic locations.
Each first aid box should be provided with first aid register book and first aid incharge should fill the Internal incident report and departmental incharge should forward to the investigation team.

**E. Display of instructions for resuscitation of persons suffering from electric shock:**

Instructions, in English or Hindi and the local language of the District and where Hindi is the local language, in English and Hindi for the resuscitation of persons suffering from electric shock, shall be affixed by the owner /occupier in a conspicuous place in every generating station, enclosed sub-station, enclosed switching station, mines and every factory as defined in clause (m) of section 2 of the Factory act, 1948 (63 of 1948). The owner of every generating station, enclosed sub-station, enclosed switching station and every factory or other premises to which these regulations apply, shall ensure that all designated persons employed by him are acquainted with and are competent to apply the instructions.

**F. Artificial respirator:**

In every manned generating station, sub-station or switching station of voltage exceeding 6520 V, an artificial respirator shall be provided and kept in good working condition.

**G. Training:**

First aid medical training shall be provided to all employees and Cardiac Pulmonary Resuscitation (CPR) training shall be provided to the employees those who are engaged in electrical work. Refresher training should be provided to first aiders periodically through authorized agency.

**H. First Aid (Situation and Procedures)**

First-aid is the immediate care given to the victim of an accident or sudden illness before the arrival of a qualified expert. The purpose of First-aid is to preserve life, assist recovery, prevent aggravation and minimize complications

**1) ARTIFICIAL RESPIRATION**

- Mouth to Mouth: This is appropriate and effective technique for emergency artificial respiration.
- Keep the head slightly backward and open the jaw.
- Seal the casualty's nose to prevent escape of air by pinching with thumb and index finger.
- Take a deep breath, open your mouth widely, place it over the victim's mouth and make a tight seal.
- Quickly blow the full breath into the mouth of victim.

- Remove your mouth from the victim and allow him to exhale passively.
- Repeat the procedure 12 to 15 times per minute, till medical aid is arranged.
- Arrange immediate medical aid.

**CAUTIONARY NOTE**

- Do not give mouth to mouth resuscitation during CPR in the presence of toxins such as cyanide, hydrogen sulphide, corrosives and organo-phosphates. Ventilate the casualty by using a face mask or bag/valve/mask assembly.
- Avoid mouth to mouth resuscitation if there is possibility of transmission of infection between the victim and the rescuer, such as HIV, Hepatitis-B, Tuberculosis, Shigellosis, Meningococcal meningitis, Herpes simplex virus and Salmonella. Use an interpositional airway device which must function effectively in both its resuscitation and protective roles, and be immediately available at all times.

**2) CONTROL OF BLEEDING**

- Apply direct pressure by thumb or finger.
- Apply dressing – gauze pad and bandage.
- Apply indirect pressure on pressure points.
- Apply tourniquet.
- Remove the injured to the hospital.

**3) FRACTURES**

- Signs of Fracture : Pain, Tenderness, Swelling, Loss of Power, Deformity
- Do not move the injured unless the life is endangered from other causes.
- Deal with the haemorrhage and breathing difficulties. Immobilise the fracture by using suitable splints.
- Immobilisation should include one joint above and one joint below the fracture.
- Remove the injured to the hospital.

**4) BURNS**

- Pour running cold water on the affected part.
- Do not apply ointments or oils or any other substance.
- Cover the wound with sterilized cloth.
- Give artificial respiration, if needed.
- Prevent shock.
- Arrange immediate medical aid.

**5) SHOCK**

- Lay the patient on his back.
- Stop bleeding, if any.
- Relieve pain by supporting the injured part.
- Keep the patient comfortable.
- Do not cause sweating.
- Fluids may be given by mouth in small amounts, if the patient is conscious.
- Reassure the patient.

- Arrange immediate medical aid.

**6) WOUNDS**

- Stop the bleeding, if any.
- Avoid touching the wounds.
- Cover the wound with sterilized cloth.
- Arrange immediate medical aid.

**7) EYE INJURIES**

- Removal of foreign body should not be attempted.
- Do not apply oil or ointment.
- Apply sterile pad and loose bandage.
- Send the patient to the hospital.

**8) ABDOMINAL WOUNDS**

- No time should be lost in sending the patient to the hospital.
- Keep the patient flat on his back.
- Give nothing by mouth.
- Maintain warmth.
- If intestines protrude from the wound, do not attempt to touch or replace them.
- Apply sterile dressing and binder on the wound.
- Provide immediate transportation to the hospital.

**9) BACKBONE FRACTURE**

- Fracture of backbone may lead to paralysis of limbs. Hence, victim should be handled with great care.
- Transport on a rigid frame, which may be improvised by using available board.
- The rigid frame is to be placed on a stretcher for transportation.
- Immediate hospitalization is needed.

**10) HEAT STROKE**

- Make the patient lie down.
- Remove all clothings except the underwear.
- Keep the patient under the fan.
- Pour cold water on the body repeatedly.
- Wash the head thoroughly with cold water and dry it with towel.
- Record body temperature falls up to 38ºC stop pouring water.
- Give plenty of cold water with a pinch of common salt in each glass of water to drink.
- Send the patient to the hospital.

**11) BLEEDING NOSE**

- Make the patient sit on a Chair with head downward.
- Pinch the nose with fingers and thumb.
- Apply ice or cold compression.
- Do not plug the nostrils.
- Do not put water or any medicine through the nostrils.
- Send for medical aid immediately.

**12) FOREIGN BODY IN THE NOSE**

- Do not try to remove the solid object.
- Ask the patient to breathe through mouth.
- Send the patient to the hospital.

**13) BLEEDING EAR**

- Lay the patient with the head slightly raised.
- Incline the head to the affected side and apply a dry dressing over the ear with loose bandage.
- Do not plug the ear.
- Apply pressure in front of the ear.
- Send for medical aid immediately.

**14) FOREIGN BODY IN THE EAR**

- Solid – Do not try to remove, scratch or probe it.
- Insects – Put a few drops of water in the ear and turn the head so that affected ear points upwards.
- Keep the head in that position for 5 minutes, then turn the head downwards so that the water flows out.
- Arrange immediate medical aid.

**15) SNAKE BITE**

- Reassure the patient
- Do not allow the person to run or walk
- Apply a ligature above the wound (in between the heart and the wound) if the bite is in the leg or hand.
- Wash the wound with potassium permanganate solution or with soap and water.
- Allow free bleeding.
- Never suck the blood from the wound.
- Treat for shock.
- Arrange immediate hospitalization, by transporting the patient in a lying down position.

**16) DOG BITE**

- Clean the wound immediately with water.
- Then wash with antiseptic soap and water.
- Do not try to stop bleeding.
- Do not cover the wound.
- Send the patient to hospital for treatment.

**17) INSECT BITE**

- The sting bite should be pulled out.
- Apply cold compression.
- Apply vinegar diluted with water.
- Soda-bicarbonate paste should be applied at the site.
- Prevent shock.
- Send for medical aid immediately.

**18) CHEMICAL BURNS OF THE EYES**

- Immediate washing of the eye with clean water at least for fifteen minute or longer.
- Apply sterile dressing over the eye.
- Neutralising agents or ointments should not be used.
- Send the patient to the hospital.

**19) SUFFOCATION**

- Remove the patient from the source
- Clean the airways.
- Restore breathing by artificial respiration.
- Send the patient to the hospital.

**20) ELECTRIC SHOCK / INJURIES**

- Do not touch the casualty while he is still in contact with electricity.
- Switch off the current at once.
- Do not attempt first aid until the contact has been broken.
- Make the air passage clear and clean.
- Restore breathing Artificial respiration and external cardiac massage, if needed.
- Call for immediate medical aid.
- Send the patient to the hospital.

**21) UNCONSCIOUSNESS**

- Make the patient lie down on his belly with head turned to one side.
- Check breathing and pulse.
- Loosen tight clothings.
- Clean the air-way.
- Give artificial respiration and external Cardiac Massage, if needed.
- Transport the patient to the hospital.

**22) POISONING**

- Find the nature of the poison
- Give universal antidote mixture as given below to drink:
    - Charcoal powder - 2 table spoons
    - Coffee powder - 2 table spoons
    - Chalk powder - 1 table spoon
- Add it to a glass of warm water and mix well.
- Send the patient immediately to the hospital.

## CHAPTER 21: COMMUNICATION SYSTEM

Communication is a key component to control an emergency in a work site. The Walky Talky, Telephone, Cell phone, Intercom etc. may be provided in the work site. Further, telephone, fax, V-set, internet communication may be provided in the plant.

## CHAPTER 22: LOCATION OF SAFETY EQUIPMENT AND EMERGENCY FACILITIES IN THE PLANT

All safety equipment, personal protective equipment, gas mask and emergency facilities such as first aid box, stretcher, artificial respiration system, ambu-bag etc. shall be kept at a conspicuous location in sufficient quantity near the work area. Defective equipment shall be discarded immediately.

## CHAPTER 23: PERSONAL PROTECTIVE EQUIPMENT/CLOTHING

### A. General:

Hazard exists in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations. Many hazards cannot be removed at source; hence, use of PPE/PPC plays an important role to work as a shield against hazards and protects the precious life of workers on the site. Every industrial/construction worker, supervisor and field engineer shall wear appropriate personal protective equipment and protective clothing which shall be adequately provided by the management. All PPE except shoe, disposable ear plug and disposable dust mask shall be for common use. High visible safety vest shall be provided to the site personal in all construction areas.

### B. Quality:

Personal protective equipment (PPE) shall be suitable for use and conform to the national (BIS) standard. Where national standard is not available, international standard (CE, EN, ANSI etc.) shall be considered. The colour of the personal protective clothing shall be grey or black as per the discretion of Head of Plant/Project.

### C. Scaling:

#### a) Personal Protective Equipment:

1. Foot protection equipment shall be issued once in a year.

#### b) Personal Protective Clothing:

1. For underground work like tunneling, two pairs shall be issued once in every year.
2. For other industrial/construction work, it shall be issued two pairs for first time and after that one pair in every year.

### D. Replacement policy:

If the damage is caused due to fair wear and tear, Head of Plant/Project will be empowered for issue of new equipment/item without any cost.

## CHAPTER 24: FIRE PREVENTION, PROTECTION & FIRE FIGHTING

### 1. General

"It is easy to prevent a fire, difficult to fight one". A fire safety program should therefore aim at preventing a fire before it starts. Equipment and system should be available to control fire at the initial stage of a fire, in case one gets initiated. Suitable fire detection and alarm system, availability of first aid fire fighting system and trained and alert manpower are the essential requirements for this.

Adequate firefighting facilities such as firefighting equipment (portable & mobile fire extinguishers, sand buckets, water tender, fire hydrant with high velocity water spray system, emulsifier, automatic CO2 release system), detection, warning and alarm system (smoke & heat detector with control panel, audible alarm and manual call point) with sufficient trained manpower shall be provided for prevention, protection and effective control of fire. Water & sand buckets and portable fire extinguishers are to be provided at appropriate places in the worksite for use during fire emergencies.

### 2. Portable Fire Extinguishers

Portable Fire Extinguishers of Dry Chemical type, Mechanical Foam, Carbon Dioxide and Sand Buckets are placed strategically in the plant for its easy availability. There are extinguishers of the above three types at NEEPCO plants. The checklist to be followed for inspection and maintenance is given in the Annexure.

Fire extinguishing equipment could be in the form of water and sand buckets, portable fire extinguisher, small bore hose-reels and hydrant system. Water, sand buckets and portable fire extinguishers are to be provided at appropriate places in the Construction / Operation / Maintenance Site for use during fire emergencies.

Fires in electrical equipment are to be treated as either Class 'A' or Class 'B' fires depending on the ingredients of the electrical equipment, but the water type and mechanical foam should not be used unless the electrical supply to the equipment is isolated. Other types suitable for Class 'A' or 'B' fires can be used on the electrical Equipment on fire even if supply is not switched off.

The type of fire extinguishers suitable for various types of fires as given below;

| Class of Fire | Type of Fire | Suitable type of Extinguisher |
|---|---|---|
| Class 'A' | Fires due to combustible materials such as wood, paper, rubber etc. | Water Buckets; Water type / ABC Powder type Extinguisher |
| Class 'B' | Fires in flammable liquids like oil, petroleum products, solvents, grease, paints, etc. | Sand Buckets; Mechanical Foam / Carbon dioxide, Dry Powder / ABC Powder type Extinguisher |
| Class 'C' | Fires arising out of gaseous substances | Carbon dioxide / Dry Powder/ ABC Powder type Extinguishers. |
| Class 'D' | Fires arising from reactive chemicals, metals, etc. (These chemicals / materials are not generally used during Operation / Maintenance stage of any plant) | Sand Buckets; Special type of Dry Powder Extinguishers. |

Note :- In case of Electrical Fire after De- energization and isolation of electrical circuit, Fire is to be treated as A or B or C Class as per material used and accordingly ABC Type , Foam Type or

CO2 Type Extinguisher can be used. Accordingly, guideline may be issued by the respective Plant/Project Safety Officer.

**Placement of Fire Extinguishers:**

(i) One 2 kg. Dry powder or $CO_2$ extinguisher within 15 m of electrical equipment (Transformer, Motor, other equipment).
(ii) The fire extinguishers should be located in such a way that a person in a work place has to travel not more than 15 m to reach the nearest extinguisher.
(iii) The extinguishers should be in conspicuous places and readily accessible for immediate use.
(iv) Generally, these are to be placed near exits, stair case, landing routes of escape etc.
(v) Access should not be blocked by materials or otherwise.
(vi) The extinguishers or buckets should be placed at convenient height, such that their bottom is 75 cm above floor level.

**3. Fire Hydrant system**

A fully operational wet hydrant system should be maintained. This should have a fire water tank connected to an electric fire pump having enough pumping capacity ( at least 137m3/ hr) and an electric Jockey pump ( pumping capacity of at least 10.8 m3/ hr). The piping system and delivery points should consist of Fire Hydrant stand pipes with single/ double discharge points depending upon the area. The hydrant system should be maintained as per IS 13039:1991. (See Annexure)

**Water Supply**

(i) At least 4.5 lakh liters of water should be stored in static tanks distributed around the Construction / Operation / Maintenance Site with due regard to potential fire risk.(As per factories rules)
(ii) If there is piped water supply, should be at the rate of 4,500 liters / min. at a pressure of 7 kg./ sq. cm.
(iii) A power driven trailer pump of min. 550 liters / minute with a towing attachment by a vehicle will be useful at the Construction / Operation / Maintenance site.

**4. Fire Detection & Alarm System**

A Fire Detection & Alarm System should be installed in the plant, consisting of Smoke Detectors and Manual Call Points. Inspection and test procedure for smoke detectors should be as per IS 2189:1999 (See; Annexure). Record of such inspection and tests shall be kept for verification.

**5. Fire Emergency Plan:-**

A written fire emergency plan should be developed for each Unit and should at least include the following:

(i) Response to fire alarms and fire systems supervisory alarms.
(ii) Evacuation of personnel not directly involved in the fire fighting activities from the fire area.
(iii) Co-ordination with the security forces to admit public fire department and control personnel movement.
(iv) Periodic fire drills should be carried out at least quarterly.
(v) Responsibilities of various agencies such as Shift Charge engineer, safety officer, Fire crew, Security etc during fire emergencies should be clearly mentioned.

**Guidelines for Fire Emergencies:-**

If any body notice fire or see / smell smoke, immediately follow these procedures:

(i) Inform the Shift Engineer / Incharge Immediately.
(ii) The Shift Engineer / Incharge should inform the Safety Officer / Asst. Safety Officer / Plant security.
(iii) The Shift Engineer / Incharge should immediately activate the Building alarm.
(iv) Shutdown equipment / cut off electric supply in the immediate area if possible.
(v) Use a portable fire extinguishers & try to control the fire, if you have received appropriate training.
(vi) Isolate the area by closing windows and doors and evacuate people from the building, if you can do so safely.
(vii) Employees should not to waste their time in collecting personal / official items. Leave the area of the fire immediately and meet in the designated assembly points.

**6. Mutual Aid Agreement**

It is desirable to have a Mutual aid agreement with industrial Units which are in the vicinity of the plant to share each other's man power and equipment in case of a fire emergency.

**7. Fire Order**

'Fire Order' for an organization identifies the possible fire scenarios that can take place in a plant and identifies the equipment and system to manage that fire. It identifies all the important authorities who have to be informed in case of a fire and also identifies their responsibilities during the handling of a fire. The 'fire order' provides the telephone numbers of all key personnel associated with decision making and management of a fire incident. The format for preparing a Fire Order is given below. Each plant should prepare and issue the 'Fire Order" after proper review and approval by the top management.

**8. Fire Squad**

A 'Fire Squad' is a select group of employees belonging to the operation and maintenance wing of the plant who are basically technical employees familiar with the plant and its systems. In the absence of a Fire Brigade it is required to train such a small group of persons who are able to identify the source of fire, isolate the system and use the available fire fighting systems to control/ fight fire till a trained fire brigade reaches the plant with their equipment and manpower to fight the fire. The availability of a fully trained fire squad is required at each plant when a Fire brigade is not available with the plant / nearest Municipal fire brigade is not within 5 km from the plant.

At least 10% of the plant employees should be trained by a professional agency to serve as a Fire squad. These employees should also consist of personnel who come in round the clock shift duty, so that in an emergency during evening or night hours trained Fire Squad is available at plant site to control and extinguish the fire. The duration of training for the fire squad should be at least one week (5 days) with theory and practical sessions.

## 1. Maintenance Check List for Fire Extinguishers (as per IS 2190:2010)

### a. Fire Extinguisher- Foam Type (Mechanical)

a) Open the extinguisher, check the liquid level. Pour liquid in separate clean receptacle to see if there is any sediment at the bottom of the cylinder: Reject the charge if there is sufficient sludge formation.

b) Examine the extinguisher externally and internally for any corrosion or damage. Damaged and corroded extinguisher should be replaced.

c) Examine the gas cartridge of mass. If there is loss of more than 10 percent of original mass, replace it with fully charged one.

d) Examine the foam generating nozzle, strainer, vent holes, internal discharge tube ceiling washer, etc. Replace them, if not in good condition.

e) Check the operating mechanism for free movement and piercing mechanism for proper working.

**b. Fire Extinguisher- Dry Powder Type (Gas Cartridge)**

All dry powder extinguishers should be inspected and maintained in accordance with the following. The dry powder extinguisher should be opened in a dry room and for a minimum possible time to avoid effect to atmospheric moisture on powder.

a) Dry powder extinguisher, where discharge control is fitted on the nozzle, should be operated before opening
b) Weigh the extinguisher to check the correct mass of powder filled in it which should be marked on the body of extinguisher
c) Open the extinguisher and remove gas cartridge and see that sealing disc is intact. Weigh and compare its mass with full mass of cartridge marked on it. In case, loss of mass is more than 10 percent, it should be replaced by new cartridge.
d) Check the operating mechanism, discharge control for fire movement and closing. Examine nozzle, hose, vent holes, piercing mechanism of cap cartridge holder, grease and wipe clean.
e) Empty the dry powder in a dry container and examine for caking, lumps and foreign matter, in which case replace it with new dry powder charge.

**c. Fire Extinguisher, Carbon Dioxide Type**

a) Examine extinguisher body externally. Damaged or corroded extinguisher should be replaced.

b) Weigh the extinguisher, compare mass against the mass marked on it for fully, charged extinguisher. It should be sent for refilling if the loss is more than 10 percent of mass. Clean and polish externally.

c) Examine hose, horn and assembly and clean. In case of trolley mounted extinguisher, examine the wheel carriage for free movement

**d. Refilling Schedule for Fire Extinguishers and Operational Test**

Extinguishers to be refilled/ operated for performance test in annually cyclic manner.
Once in Two Years

a) Portable fire extinguisher, water type- stored pressure.

b) Portable fire extinguisher, mechanical foam- stored pressure.

Once in Three Years'
BC and ABC powder extinguisher

Once in Five Years
a) Portable fire extinguisher, mechanical foam type
b) Fire extinguisher, carbon dioxide type

**e. Hydraulic Pressure Testing of Fire Extinguishers**

Every extinguisher installed in premises shall be hydraulically pressure tested as per the schedule given below. There shall not be any leakage or visible distortion. Extinguisher which fails in this requirement shall be replaced.

| Sr no. | Type of extinguisher | Test pressure Kg/cm$^2$ | Pressure maintained for min. | Test interval year |
|---|---|---|---|---|
| 1 | Water type (gas cartridge) | 35 | 2.5 | 3 |
| 2 | Water type (stored pressure) | 35 | 2.5 | 3 |
| 3 | Water type (gas cartridge) | 35 | 2.5 | 3 |
| 4 | Mechanical foam type | 35 | 2.5 | 3 |
| 5 | Dry powder (stored pressure) | 35 | 2.5 | 3 |
| 6 | Carbon dioxide | 35 | 2.5 | 3 |

The $CO_2$ type and clean agent type fire extinguishers shall be pressure tested every time when the cylinders are sent to recharging

**2. Inspection and Maintenance of Fire Hydrant System (IS 13039: 1991)**

Each hydrant provided in the area should be inspected as often as possible. However for industrial establishments, such inspections for each hydrant should be carried out at intervals not exceeding once every week.

The following action should be taken during the monthly/weekly inspections:

a) The valve spindles should be checked for signs of excessive wear including leakage in the gland.
b) The valve should be opened slightly to see that water is flowing freely and there is no obstruction.
c) The paint work of the hydrants, pit covers, indicator plates, etc, should be checked.
d) Brass parts should be cleaned and polished.
e) All cut off (isolating) valves should be operated and oiled, once a month.
f) Isolating (cut off) valves should be thoroughly overhauled annually to remove sludge and other foreign matter collected in valve seating.
g) Apart from the monthly/weekly inspections, the performance of the hydrants should be thoroughly checked during the fire fighting operations and regular drills and practices.
h) The practices should be so arranged that the maximum number of hydrants in different areas is operated in rotation.
i) Testing of pressure and output in different areas covered by the hydrant system should be carried, at least every quarter.
j) Hydrant mains should be tested with the pump delivering at its maximum pressure with all the hydrants outlet closed and thereafter, with at least three adjacent hydrants opened to see that the hydrant yield the minimum output of 125 litres per minute at a minimum pressure of 5.25 kgf/cm$^2$ or higher, if needed.

**3. Inspection & Test of Fire Detection and Alarm System as per IS 2189**

The following check-list and test sequence should be carried out Quarterly by the User

a) Batteries and their connections should be examined and tested to ensure that they are in good serviceable condition.

b) Where applicable, secondary batteries should be examined to ensure that the specific gravity of electrolyte in each cell is correct.

c) The alarm function of control and indicating equipment should be checked by the operation of a trigger device in each zone.

d) The visual inspection should also confirm that a clear space of at least 750 mm radius is preserved in all directions below every detector,

**Annual Inspection Tests**

The following checks and test sequence should be carried out:

a) The instruction and test routines detailed above

b) Operation of at least 20 percent of the detectors in an installation should be checked each year and the selection should be done in such a way that all the detectors in an installation shall have been checked once in every 5 years

c) Each detector should be checked for correct operation using specified test equipment and method.

d) Visual inspection should be made to confirm that all cable fittings and equipment are secure, undamaged and adequately protected.

**4. Fire Safety In Cable galleries/ vaults ( as per IS 12459: 1988)**

The entire cable run should be protected by automatic fire alarm system. The following types of detectors may be used depending upon the circumstances:

a) Smoke Detectors (IS 11360- 1985)
b) Heat detectors linear type, and
c) Heat detectors (IS: 2175-1988).

Long cable runs should be compartmented and each compartment should be considered as a separate zone for installation of detectors (IS 2189:1988 ).

The linear detectors may be used for each cable or for bunch of cables.

**a. Fire Extinguishing System**

In addition to the fire detection and alarm system an automatic fixed fire extinguishing installation should also be provided for long cable runs as in case of heavy industries, electricity generating stations, etc.
The automatic fixed fire extinguishing Installation employ any of the following extinguishing media, according to the operational requirements.

a) Water,
b) Carbon dioxide (IS: 6382-1984)
c) Clean agent, and
d) High expansion foam.

**b. Miscellaneous**

1. Self-contained breathing unit should be installed in substations, cable basements and cable tunnels, where ventilation has not been provided.

2. Cable tunnel floor should have a slope leading to a sump for collecting seepage and other water including that used for fire fighting and should be provided with sump pump.
3. Entry of personnel into cable tunnels and galleries should be strictly controlled through work Permit system. No one should use these premises for rest and carrying eatables.
4. No welding or naked fire should be allowed inside the cable gallery.
5. All cotton wastes and waste paper should be disposed in self closing metallic containers.
6. Identify all the activities / location where there is a potential for fire and explosion.
7. Do not keep any flammable material near the potential hazardous area and electrical points.
8. Ensure that nobody smokes inside the identified fire prone areas.
9. Ensure that the electrical earthing is in place.
10. Follow safe electrical practices while handling electrical equipment, machinery and lines. Use Rubber mats, Electrical Grade Gloves, Shoes wherever required.
11. Do not allow any spillage or leakage in working Area; in case any spillage is noticed, immediately wipe off with cloth. Throw the cloth in the designated bin.
12. Make sure that non-compatible materials are not kept together, especially chemicals. Also, good electrical practices to be in place e.g. no naked wires etc.
13. Ensure availability of adequate number(s) of appropriate type Fire Extinguishers in the fire prone places.
14. Keep yourself informed about the type and class of fire and appropriate extinguisher to be used.
15. Participate actively in the periodic Mock Drills to ensure emergency preparedness.

Adequate firefighting facilities such as firefighting equipment (portable & mobile fire extinguishers, sand buckets, water tender, fire hydrant with high velocity water spray system, emulsifier, automatic $CO_2$ release system), detection, warning and alarm system (smoke & heat detector with control panel, audible alarm and manual call point) with sufficient trained manpower shall be provided for prevention, protection and effective control of fire. Water & sand buckets and portable fire extinguishers are to be provided at appropriate places in the worksite for use during fire emergencies.

## CHAPTER 25: CONTROL OF NOISE

1. Ensure the availability of PPE like ear muffs/ ear plugs and insist to use the same.
2. Ensure the display of awareness Boards to insist on usage of PPE at work locations that are noise prone zones.
3. Check the condition of doors of all the enclosures, gaskets, sealing under normal conditions ensure the doors to be closed. Under abnormal conditions of noise check the equipment for leaks of oil, vacuum conditions etc.
4. Inform maintenance staff for attending abnormalities.
5. Ensure the periodic checking of PPE for their effectiveness/healthiness.
6. If a PPE is found defective, replace the same.
7. Never open the acoustic doors of the Diesel Generator Sets while it is running.

## CHAPTER 26: SAFETY IN WASTE DISPOSAL

Waste management or disposal is the process required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management including recycling.

### A. General:

Waste such as jute and clothes used for cleaning of machinery, damaged gasket and rubber seal, fused bulb etc. shall be disposed suitably so that no pollution of air, water and soil can take place. The following measures shall be taken to control of pollution:

1. Segregation into Bio-degradable and Non-Biodegradable waste.
2. Temporary collection of waste on site. Disposal of waste at identified/ authorized location.
3. Dumping of non-biodegradable waste in designated dumping areas having concrete floor. After sufficient accumulation, the waste shall be disposed off through suitable agency.
4. Biodegradable waste shall be collected from different areas and dumped in designated area away from human habitation.
5. Display board to be installed to educate the employees to avoid wastage of goods. Awareness among the employees shall be imparted during work place inspection.

### B. Hazardous waste:

Hazardous waste means any waste which causes danger to health or environment, whether alone or when in contact with other waste. The key objectives of hazardous waste management are to minimize the hazardous waste in terms of quantity, to dispose off as close to the source and reduce the Trans boundary movement.

#### a) Provisions:

1. Every hazardous waste handling / generating unit is responsible for collection, reception, treatment, storage and disposal of hazardous Waste.
2. Mandatory authorization from the State Pollution Control Board is to be sought for collection, treatment, storage and disposal of hazardous Waste.
3. Import and export of hazardous waste is not permitted for dumping and disposal.

4. Import and export of hazardous waste is permitted as raw materials for recycling and reuse subject to the compliance of procedure prescribed involving the grant permission from MoEF for such import and export of hazardous waste.
5. Hazardous waste generating units shall dispose their hazardous waste at a common disposal site(s)identified and finalized after a proper environmental impact assessment.
6. Recyclers /re-refiners of non-ferrous metal, waste/used oil are required to register themselves with CPCB. Owner or occupier generating specified non-ferrous metal waste or generating used oil or waste oil of 10 tons or more per annum are required to sell to auction such waste only to a registered re-refiner or recyclers.
7. The high power committee constituted in pursuance of the Honourable Supreme Court has suggested that all the industries involved in hazardous chemicals and generating hazardous wastes display online data outside the factory gate, on quantity and nature of hazardous chemicals being used in the plant as well as water and air emissions and solid wastes generating in the factory premises. In case of failure to do so the units may even be asked to close down.

**b) Common pre-requisites for obtaining authorization for storage under Hazardous waste (management & handling) Rules:**

1. Display of updated data outside the main factory gate in two boards of size, 6 feet x 4 feet, both in English and Hindi and the local language.
2. Storage facility shall have appropriate containment system.
3. The container/enclosure holding hazardous waste shall be marked (Hazardous Waste) in red colour in English/in Hindi and shall bear the prescribed label.
4. The occupier must take precautions to prevent any accidental ignition or reaction of ignitable or reactive waste.
5. The containment system shall be leak proof and able to drain / remove liquids.
6. Units that store hazardous waste shall do so in such a manner that it does not in any way contaminate the environment or the ground water due to air / rain / seepage /leakage etc.

**C. Disposal of hazardous waste:**

1. Segregate the Hazardous waste from general waste such as Oily cloth/ oily soaked cotton waste, empty chemical containers, empty paint containers, e-waste from electronic data processing, oil filters, oil bearing strainer, oil bearing contaminated residue from centrifuge, oil bearing cartridge filter, contaminate collector from electronic liquid cleaner.
2. Ensure that there is no spillage of waste during handling; use Personal Protective Equipment as may be required.
3. Collect hazardous waste in drums during maintenance activities or as required.
4. Collect used or spent such as oil, Lubricants, Waste coolant, strainer cleaning waste water from centrifuge, metallic cartridge cleaning waste water in drums during maintenance activities or as required.
5. Ensure that there is no spillage of oil during handling.
6. Collect the oil in designated Leak Proof MS / Fibre Drums only.
7. Ensure that the drums are not damaged / leaking. Label the containers as per the Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules.
8. Send hazardous waste to the Scrap yard for proper storage and maintain record in Form 3 of the Hazardous Wastes (Management, Handling &Trans-boundary Movement) Rules.
9. Load them in and keep in designated area only.
10. Ensure to keep the waste oil drums in concreted storage areas only.
11. Follow the Hazardous Wastes Authorization conditions as received from state Pollution Control Board.

12. Check for the Authorization of the Dealer to whom the waste oil drums are sold for recycling and ensure that he is registered with the State Pollution Control Board as Authorized Recycler. Get the List from the Central Pollution Control Board Website http://cpcb.nic.in; also ensure the validity of the Certificate of the Agency as well as the Capacity allotted.
13. Dispose off the waste oil as per the method prescribed in the aforesaid "Authorisation". While disposing-off waste oil, give Transport Emergency (TREM) Card to the transporter.

**D. Disposal of Bio-medical waste:**

1. Place colour coded bins at various identified sites in Hospital such as casualty section, laboratory, labour room, male and female wards and major and minor OT.
2. Used disposable syringes are rinsed with 1% Hypochloride Solution, and then cut with needle cutter. Other plastic wastes such as I.V. catheter, rubber tubes, and plastic bottles are cut into two pieces and stored into specified container for safe disposal.
3. All soiled dressing materials such as cotton, gauge, leucoplast tape, catgut, placenta etc. are stored in specified bins for safe disposal within 48 hours by deep burial method.
4. X-ray is done following the required protective measures such as using radio opaque aprons, lead shield. Monitoring of radiation exposure of X-ray technician is done on quarterly basis from BARC approved agencies.
5. Disposal of developer and fixer used for X-ray are done by discarding into the concealed drain leading into the concealed drain leading into the septic tank.
6. Waste material from laboratory such as used chemical, urine, stool & blood samples are flushed out into the concealed drain leading into the septic tank after disinfections by chemical treatment.
7. All medical and paramedical staff shall wear aprons and use hand gloves, face masks while attending the patients in indoor and outdoor wherever required.
8. To ensure the deployment of trolley for loading & unloading of waste from container and transport it to suitable places such as secured disposal yard.

**E. Disposal of E-waste:**

"E-waste" means the electrical and electronic (E&E) products which are at the end of their useful life. It is generated from different IT & telecommunication equipment and consumer electrical / electronic products, such as computers, printers, televisions, mobile phones, fridges, washing machines, dryers, music system, copiers and fax machines. The E&E products are homogenous solid components containing heavy metals, polymers, flame retardants, polychlorinated biphenyls etc. The e-waste contains number of toxic components that can cause serious damage to environment and human health if discarded in an environmentally unsound manner. The e-waste is regulated under "The E-waste (Management and Handling) Rules, 2011.

A strategy of 3R (Reduce, Reuse, Recycle) shall be adopted for e-waste disposal.

1. Reduce the generation of e-waste through smart procurement and good maintenance.
2. Reuse still functioning electronic equipment by donating or selling it to someone who can still use it.
3. Recycle those components that cannot be repaired. Use only authorized recyclers for disposing the e-waste products.

**F. Collection, storage and disposal of mercury-containing lamps:**

Mercury-containing lamps include small compact fluorescent lamps (CFLs) and linear fluorescent tubes commonly used in commercial and public buildings, offices, plants, workshop and other workplace and high intensity discharge (HID) lamps used for illumination of street and compound. Generally, the higher

the power usage, the more mercury is required to operate the lamp. Mercury is a potent neurotoxin and exposure shall be avoided. It is a non-bio degradable product.

**a) Collection:**

1. High level and low level mercury bulbs can be collected in the same container for proper disposal.
2. Place used tubes in designated storage area.

**b) Storage:**

1. An area shall be designated as the storage area. This area must be in a secure area; the loading dock is not permissible unless in a gated area.
2. Used tubes cannot be stored for more than a year.
3. Used tubes must be stored in a container.

**c) Labeling:**

All containers of tubes must be labeled at the start of filling with "Universal Waste - Lamps" and date.

**d) Disposal:**

Mercury-containing lamps can be recycled as an alternative to landfill disposal. Used and unserviceable mercury-containing lamps can be disposed to specialty recyclers who are capable of safely recover not only the mercury, but also the glass, phosphorus and aluminium contained in the lamps.

## CHAPTER 27: COMPRESSOR AND COMPRESSED AIR LINES

1. Ensure that there is no oil leakage from the compressors.
2. In case of oil leakage, arrest it immediately & keeps the oil in a tray for reuse.
3. Check and maintain oil level as per the marking provided at the machine.
4. Put old/ used spares, waste cloths in the designated bin.
5. Use ear plugs/ muffs in the compressor area, when it is in operation.
6. Check and arrest any air leakage from valves, flanges, pressure gauges etc., check for any pinholes and drop in desired air pressure. In case any deviation is found, get it corrected immediately.
7. Maintain pressure as per process requirement.
8. Display the safe working pressure (range) in the compressor and also mark the same suitably in the pressure gauge.
9. Drain moisture from the Air reservoir once in a day.
10. Do preventive / scheduled maintenance as per Manufacturer's recommendation and statutory testing (as applicable).

## CHAPTER 28: AIR CONDITIONING AND VENTILATION SYSTEM

### A. General:

1. Check compressor for any leakage of oil & Refrigerant (R122/R134A)
2. Check discharge and suction line pressure to observe any abnormality.
3. Check all pumps of AC & Ventilation systems for any abnormality.
4. Check all pipelines of AC & Ventilation system for any abnormal behaviors.
5. Logging of all temperatures of AC & V system to monitor healthiness of system.
6. Check the heat exchangers for any choking.
7. Ensure that thermal insulation provided on pipes is in good conditions.
8. Change of duty cycle of compressors.
9. Check functioning of all temperature controllers.
10. Note down the readings of all pressure gauges provided in the systems for any abnormal behavior.

### B. Energy conservation:

1. Put off the lighting during daytime – use daylight to the extent possible.
2. Ensure that all temperature controllers are working satisfactorily.
3. Use Air Conditioners only when required and ensure to carry out periodic maintenance.
4. Switch on and off all building lights timely.
5. Ensure that all power factor correcting panels are working satisfactorily.
6. Switch off all fans / AC's / Coolers / Heaters when not required or moving out of the cabin / work area.
7. Ensure to switch off the control panels of the machines when it is not use.
8. Keep your Computer Monitors in energy saving mode; do not keep the printers / accessories in "ON" condition.
9. Regularly clean the reflectors in the lighting fittings.
10. Use the water pumps judiciously.
11. Switch 'OFF' all lights of non-essential areas.
12. Do's for Energy Conservation as follows:
    (i) SWITCH OFF light when it is bright.
    (ii) Use wire of proper size in house wiring to reduce loss of energy.
    (iii) Use ISI standard electrical fittings and fixtures.
    (iv) Keep lamps and fixtures free from dust and dirt.
    (v) SWITCH OFF the stabilizer when appliance is not in use.
    (vi) Clean Air-conditioner, Desert Cooler pads and Refrigerator radiator periodically.
    (vii) Use stairs more.
    (viii) SWITCH OFF lights and fans while leaving the room.
    (ix) Use LED lights instead of bulbs.
    (x) Lubricate motor and motor drives regularly to reduce friction.
    (xi) Motors shall be kept clean to help them cool properly.
    (xii) A motor shall be placed as close to the load as possible.
    (xiii) Match motors to your requirement. Oversized motors waste energy. Use motors of high efficiency.
    (xiv) Use shunt capacitors across motor terminals to reduce KVA charges and also avoid damage to motors.
    (xv) Tighten belt and pulley at regular intervals to reduce loss of energy due to 'Slip'.
    (xvi) Replace worn out bearings immediately and ensure timely repairs.
    (xvii) Make greater use of daylight.

## CHAPTER 29: SAFETY IN TRAFFIC MANAGEMENT

### A. Guidelines to drivers:

1. Keep your vehicle in good working condition especially its critical systems like brakes, gears, electrical and tyres.
2. Maintain your vehicle to keep auto emissions under control.
3. Only licensed persons shall drive.
4. Obey the vehicular traffic signals and traffic signs.
5. Always give way to the pedestrians.
6. Drive Defensively: know traffic rules; have courtesy and consideration for other road users; be alert and keep allowance for illegal actions and errors of others.
7. Drive within speed limits.
8. Always keep to the left of the road.
9. Follow lane discipline. Do not cut lanes.
10. Drive carefully at blind corners.
11. Overtake only from the right, unless the vehicle ahead intends to take a right turn. Check position of vehicles in the rear through the rear-view mirror.
12. To avoid the risk of overturning, do not over speed while turning or cornering.
13. When approaching an intersection, drive carefully to avoid collisions.
14. When entering a main road at a junction, give way to traffic on the main road and stop if necessary.
15. Maintain a safe distance between two vehicles.
16. To prevent rear end collisions, signal your intention well before and slow down smoothly so as to give the following driver enough time to react.
17. While driving at night, watch out for vehicles with only one headlight on.
18. Do not use headlights to dazzle the oncoming traffic. It can affect you too.
19. Drive with additional care and at lower speeds, when the visibility is poor or in adverse weather conditions.
20. While negotiating through water logged stretches, drive close to the centre of the road.
21. To avoid skidding, be alert for polished or slippery road surfaces, especially after a drizzle; do not brake suddenly while cornering and replace worn out tyres.
22. Don’t drive when drowsy or tired; take rest while on long distance journeys.
23. Avoid intake of alcohol or other intoxicants before driving.
24. Do not horn unnecessarily. It distracts other drivers.
25. Park only at authorized and safe spots.
26. When parking, set the hand brakes, leave the vehicle in gear and remove the ignition key.
27. While reversing, lookout for children, ensure that there is sufficient space at the rear and give a proper signal.
28. Wear seat belts.

### B. Additional Guidelines to two wheeler riders:

1. Helmet is a must for both rider and pillion rider.
2. Do not ride on the painted road makings to avoid skidding.
3. Always use rear-view mirrors. Use proper hand signals while turning.
4. Never park close to a big vehicle in the blind spot area of the driver.

### C. Guidelines for vehicle occupants:

1. Always check that the doors are locked.
2. Do not project your hands out of the window.

3. Do not throw cigarette stubs or other waste from the vehicle.
4. Do not allow children to play the fool in the car.
5. Do not do anything which may distract the driver.
6. Do not give instructions to the driver.
7. While opening doors, observe other traffic, cyclists and pedestrians.
8. Do not get on or jump off moving vehicles or alight at road signals.

**D. Guidelines to Pedestrians:**

1. Always walk on the footpath and where there is no footpath, walk along the right hand side of the road facing the oncoming traffic.
2. Always cross the road at zebra crossings, over bridge or subways, wherever these exist.

**E. Emergency measures in the event of an accident:**

1. Switch off vehicle ignition to avoid sparking which may start a fire.
2. Warn all other traffic and contact the police.
3. Scan casualties according to degree of injury and give first aid.
4. Do not handle the cases of fracture unless you are trained to do so. Wrong handling could prove fatal.
5. Keep a cordon around the accident spot and particularly avoid crowds thronging around the victim.
6. Take assistance of passing vehicles / bystanders to arrange for medical attention.

## CHAPTER 30: SAFETY FEATURES AND SAFE USE OF LIFTS

Failure of lift is very common with greater use of lifts. Injuries sustained in lift accidents are often severe and even fatal because many lift accidents involve the fall of victim from great heights.
Hazards associated with lifts: Exposed lift shafts, improper leveling of the lift car with the floor level, improper functioning of electronic eyes- the mechanism used to control the closing of lift door, sudden drop of the lift car, exposed parts carrying electrical current

**A. Safety features to be provided in the lift:**

1. Lifts should be inspected by competent person atleast in 6 months as per the factories Act 1948 and its records should be maintained and lifts should be maintained as per the section 28 of the factories Act 1948. It is the responsibility of head of concern department to get it tested by the competent person.
2. Every hoistway & lift way shall be sufficiently protected by an enclosure fitted with gates & the hoist and lift & every such enclosure shall be constructed as to prevent any person or thing from being trapped between any part of lift & hoist & any fixed structure & moving part.
3. The max. SWL, test date, due date shall be plainly marked on lift & no load greater than SWL shall be carried.
4. Cage of hoist or lift used for carrying persons shall be fitted with a gate on each side from which access is afforded to a landing.
5. Every gate shall be fitted with inter-locking /other efficient device to secure that the gate cannot be opened except the cage is at the landing & cage can't be moved unless the gate is closed.
6. efficient device shall be provided & maintained capable of supporting the cage together with its max. load in the event of breakage of ropes, chains, or attachments.

7. An efficient automatic device shall be provided & maintained to prevent the cage from over-running.
8. Segregation of electric supply lines- To safeguard the users, the electrical supply lines are to be segregated voltage wise. Car shall be taken that whichever part of a lift comes in contact with users has minimum possible supply voltage.
9. Over speed governor- To bring the lift car to rest by operating the safety gear in the event of over speeding in the descending direction exceeding a pre-determined limit. Safety gear is attached to the car bottom frame to stop and hold the lift car on guide rails in the event of free fall or over speeding in descending direction.
10. Car leveling device- To move lift car at a reduced speed within a limited zone and stop subsequently to level with the lift landing.
11. Interlocks to landing and car door- To open lift landing and car door only when the lift car is in the landing zone.
12. Down final limit- To avoid the lift to over travel in the downward direction below ground floor and hit on the buffers in the pit.
13. Up final limit- To avoid the lift to over travel in the upward direction beyond the top floor and hit on the ceiling of the machine room.
14. Emergency stop switch- To stop the lift instantly during emergency anywhere during ride.
15. Emergency alarm- To obtain assistance in case of emergency.
16. Pit switch- To avoid the operation of the lift by any means when persons have entered in the pit for any maintenance work and are safely guarded from the lift to come down.
17. Provision for emergency light in the Lift in case of Power Failure is to be provided.

**B. Safe use of lifts:**

1. Do not panic in case of the elevator getting trapped between floors. Press emergency alarm button.
2. Do not jump out of the elevator before it comes to the floor level.
3. Do not jump inside elevator when elevator is in motion.
4. Do not try to force open/close power operated doors.
5. Do not overload the elevator than the rated load.
6. Do not open the manual doors when elevator is in motion.
7. Do not rest on the door panel.
8. Do not allow seepage or water accumulation in the elevator pit, shaft and machine room.
9. Passenger elevator shall not be used for transfer of heavy and bulky articles.
10. Operate the button gently and only when required.
11. Keep the machine room neat and tidy.
12. Keep the machine room key easily accessible.
13. Display the service provider’s contact number in the elevator cabin and at ground floor.
14. Don’t use lift in case emergency such as fire, earthquake etc. Use staircases.

## CHAPTER 31: PREVENTION OF UNAUTHORIZED ENTRY AND PERMIT TO WORK SYSTEM

Unauthorized entry at hazardous or dangerous operations /activities / areas shall be prevented by having a proper safety system, regulating entry through gate pass and permit.

It is a written statement containing information and instructions pertaining to hazards that are to be avoided in a particular operation. It indicates that all hazards have been considered in advance and that foreseeable appropriate precautionary measures have been taken. People responsible to execute a job defined in the permit are to review them from the point of compliance. A permit is a written consent of the owner/issuing authority that guarantees proper and safe conditions where personnel can work safely by complying with the instructions on the permit. It also indicates that the people executing the job have reviewed the permit and accept responsibility of adhering to the instructions and limitations stipulated. Thus a permit finally becomes a document of consent by both parties, i.e. the owner/issuing authority and job executor.

**Issuer of permit**: Designated person authorized to issue work permit. The issuer shall be HOD of that department (O & M plant) or site incharge.

**Receiver:** Designated person authorized to receive work permit. The issuer shall be engineer of that department (O & M plant) or site engineer.

The permit shall have 3 Copies. One copy would be available in the issuer, one i.e. main copy with the receiver and one with the safety department. Main copy should be returned to issuer by the receiver after the completion of work for which permit has been raised.

### A. Types of Work Permit:

General work permit, work permit for entry into tanks / confined space, hot work permit or work on pipeline carrying flammable materials, work permit for electrical shutdown (plant/line maintenance work), work permit for working at height / fragile roof, work permit for excavation / digging / breaking floors.

### a) General work permit system:

This is a permit issued to works of routine nature such as lifting, shifting, transporting, in-house cleaning, replacement of fused lamps, garden maintenance, housekeeping activities etc. The permit will be issued by the officer in-charge having the proprietary control of that area only after identifying the possible hazards during the course of work & ensuring proper control measures are taken.

### b) Entry into tanks / confined space:

Confined space: It is an enclosure with known or potential hazards and restricted means of entrance and exit, is not normally occupied by people, and is usually not well ventilated.

This permit is required for the protection of personnel entering a confined space such as Vessels, boilers, storage tanks, large diameter piping, deep trench / pit etc against hazards such as oxygen deficiency, toxic and flammable materials, falling objects, power driven equipment etc. Excavation more than 1.2 meter deep, entry on floating roof tanks when the roof are more than 3 meter down from the top, space located below ground level such as pits, drain channels etc. also fall under the confined space. Obtain permit as per Annexure IV.

A written certificate is to be given by the competent person based on test carried out by him and stating that the space is reasonably made free of all hazards and is fit for persons entering it. The person who enters into the tanks/ confined space shall wear suitable breathing apparatus and a belt securely

attached to a rope, free end of which is held by a person outside the confined space. Usually the Engineer having the proprietary control over the equipment/vessel issues a safe entry permit and authorizes entry and work in, on and around a confined space. Before issuing such a permit, it will be his responsibility:-

(i) to isolate the equipment/vessel from all sources, through which any energy, stock or harmful substances can get introduced, by disconnecting, blinding, blanking etc.
(ii) to drain, clean, wash and purge the equipment / vessel to make it free from toxic gases and other harmful substances,
(iii) to test the air inside the vessel to determine presence of explosive mixture, toxic gas, oxygen sufficiency etc. In case of presence of explosive mixture / toxic gas or deficiency of oxygen, it shall be further ventilated, till such time the explosive mixture / toxic gas is removed or the oxygen content is adequate,
(iv) to ensure all electrical / pneumatic/ hydraulic equipment/ drives been disconnected,
(v) to ensure the persons required to enter confined space been trained in dealing with specific hazards,
(vi) to ascertain only 24V hand lamps are used for the purpose of illumination. However, care shall be taken to ensure that the 24V transformer is kept outside the confined space,
(vii) to engage a rescue team equipped with emergency rescue devices put on standby.

In case of deficiency in oxygen that cannot be improved upon, entry into the vessel / equipment shall be strictly restricted to the use of adequate breathing apparatus, and the usage of breathing apparatus shall also be restricted to Self Contained Breathing Apparatus (SCBA) or a Supplied Air Line Respirator. The person using SCBA shall be trained about the use and its limitations. As far as practicable two man ways or other openings on the equipment / vessel shall be kept open for cross ventilation. After ensuring all the above points, the operating engineer shall prepare adequate number of safe entry permits and display conspicuously at each point of entry. Any other precautions to be taken for entry shall be clearly specified on the permit. Persons entering into a vessel / equipment, that has been declared as safe to enter by exhibiting safe entry permit, must read the safe entry permit carefully and strictly obey and comply with all the instructions detailed on the safe entry permit.

**c) Hot Work Permit**:

Hot Work: An activity that can produce a spark or flame or other source of ignition having sufficient energy to cause ignition, where the potential for flammable vapors, gases, or dust exists.

All hot work such as welding, grinding, gas cutting, burning, shot blasting, soldering, chipping, excavation, open fire, use of certain non-explosion proof equipment, Entry / operation of petrol or diesel or petroleum products driven vehicles or equipment in hazardous area, any work which can produce heat / spark etc. shall be carried out through Hot Work Permit. Obtain permit as per Annexure V.

Hot Work in General Open Area: The arc shall be free from any combustible material. Area of welding/ gas cutting shall be condoned out. Adequate fire extinguishing material and water availability shall be ensured. Proper PPE such as apron, welding goggles, and welding shield shall be used.

**I. Hot Work at Height**: Care shall be taken to see that the sparks arising out of welding/ gas cutting are contained & do not make a free fall by providing a coverage of fire resistant cloth/ sheet below the welding / cutting activity. However area just below the welding/ cutting activity & ground floor shall be condoned out and entry shall be prevented to avoid accidental fall of welding/ cutting splinters. The adequate fire quenching facility shall be provided.

**II. Hot Work in Confined Space**: The area within shall be purged with copious amount of fresh air if it contained any flammable, toxic & any other material that is not conformable to human life & health. No part or portion or surface of the confined space shall be made / comprise of combustible material such as rubber, plastic, poly propylene, etc. that can generate fire by virtue of hot

work. Proper exhaust systems/ fume extraction system shall be provided to take out welding fumes & other gases arising out of hot work. Oxygen sufficiency shall be ensured within confined space. The hot work shall be conducted on a continuous basis. Regular rest breaks shall be at every 15/20 minutes after welding/ cutting. The person performing hot work shall be provided with necessary PPE including online breathing apparatus. Adequate fire quenching devices shall be made available. The job shall be done under strict supervision.

III. **Hot Work near combustible material, tanks, containers, pipelines carrying Flammable substance**: Explosivity of general ambient shall be checked for absence of flammable mixtures. Job shall be strictly supervised. Fire-quenching media shall be made available at site.

**d) Work permit for working at height/fragile roof**:

In the event of any person required to stand, pass over or work on or bear any roof of ceiling covered with fragile material or required to work at an elevation of more than 3 meters height, adequate safety measures shall be provided to prevent falls. For this purpose it is suggested to use ladders, crawling board and safety belt etc. Each time a person is required to work on the fragile roofs or at higher elevations, the job shall be carried out under the authority of a work permit issued by concerned department having responsibility of the area. Obtain permit as per Annexure III.

**e) Work permit for excavation/digging/breaking floors:**

The originator of the permit having proprietary responsibility of the area where excavation work is intended to be carried out will prepare the excavation permit in duplicate, indicating the exact location where the excavation work will be carried out and sends both copies of the permit to the plant maintenance department. The plant maintenance engineer studies the relevant drawing of the area to be excavated and determines whether any pipelines or electrical/communication cables are located in the area. If any such obstacles are seen, he prescribes the special precautions to be taken while excavating, and puts his signature on the permit. One copy of the permit is retained by the originator and the duplicate handed over to the agency executing the job. Obtain permit as per Annexure VI.

**f) Electrical Work Permit System:**

Work on electrical installations, equipment and apparatus is considered to be very hazardous. Therefore, it is of utmost importance that sufficient safety precautions are taken before carrying out any work on electrical circuits, lines and equipment. Hence, to exercise greater control over such work and to ensure that adequate precautionary measures are taken before commencement of work on electrical equipment, an Electrical Work Permit system shall be developed. This permit is issued to carry out work on electrical equipment, installation after completely de-energizing the equipment from electrical energy & providing effective grounding. The electrical permit shall clearly indicate – The equipment / installation under work, the person who is handling the work, duration of work, type of work that is to be carried out, points/ means of isolation indicating each point of isolation, grounds provided to the equipment, additional precautions required if any to be indicated on the permit. The permit shall be signed by the issuing authority & also by the executing authority. All work shall be carried out under the supervision of a competent supervisor. If more than one department is working on the same apparatus, a permit to work shall be issued to the person in-charge of each department. No construction, repair or maintenance work in the proximity of high or EHV system / equipment ( electrical or mechanical) where technical knowledge or experience is required to avoid danger, shall not be carried out unless a permit of work on the prescribed form has been issued by the shift in-charge to an authorized person. The person issuing a permit to work shall ensure that the system/equipment is made perfectly safe for working. In the

case of electrical system/equipment, the isolation shall be complete, the metal parts adequately earthed and danger notices attached at suitable places. In the case of mechanical equipment, the isolation shall be complete and conditions rendered safe and danger notices applied at suitable places. Work permit shall be made in duplicate. Original copy of the permit is handed over to person in-charge of the work. The carbon/duplicate copy shall be retained by the shift in-charge. Permit books are important records and shall be compiled safely. All pages shall be kept safely. No page shall be detached or used for any other purpose. If a page is inadvertently detached, it shall be recorded and duly signed in the book by the person concerned. The issue of permit to work, nature of repair carried out, transfers, if any, cancellation of permit are to be noted in the Log Book maintained by the permit issuing department. The Person in-charge shall be responsible for identifying the isolated and de-energized circuit. After completion of the works of removal of men/material (tools and tackles), the person in-charge of the works shall inform the person issuing the permit regarding completion of work and shall surrender the original work permit for cancellation of it.

Carryover of work over to next shift: As far as possible the work shall be completed in the same executing shift. If it is not possible the earlier work permit shall be cancelled by the working party & a fresh permit for the same job shall be issued to the person taking over the equipment for work in next shift. Care shall be taken to clearly indicate the existence of ground connection to the equipment and other conditions related to equipment by the person in the previous shift to the person in the next shift. Obtain permit as per Annexure VIII.

**General Instructions for Work permit system:**

a) The work permit shall be filled up carefully and accurately in clear handwriting ensuring that complete information is provided in all sections / subsections and none of column is left blank. Sketches should be provided wherever possible to avoid miscommunication.

b) Appropriate safe guards and required personnel protective equipment shall be determined by a careful analysis of the potential hazards and the operations to be performed prior to starting the work.

c) In case of fire alarm / siren, all work must immediately be stopped.

d) For renewal of work clearance, the issuer shall ensure that the conditions are satisfactory for the work to continue. If the conditions have changed, it may be necessary to issue a new permit or amend the existing permit.

e) This clearance on the same permit can be renewed / extended upto a maximum of seven calendar days.

f) This permit must be available at work site at all times.

g) On completion of the work, the permit must be closed and kept as record.

h) Issuer or safety department may add other relevant instructions based on their operating and maintenance practices.

## CHAPTER 32: GUARDING OF ROTATING PARTS OF MECHANICAL EQUIPMENTS AND HYDRAULIC WORKS

1. Every moving part of a prime mover and every fly-wheel connected to a prime mover, whether the prime mover or fly wheel is in the engine house or not, the headrace and tailrace of every water wheel and water turbine, any part of a stock-bar which projects beyond the head stock of a lathe, every part of an electric generator, a motor or rotary converter, every part of transmission machinery and every dangerous part of any other machinery shall be securely fenced by safeguards of substantial construction which shall be constantly maintained and kept in position while the part of the machinery are in motion or in use.
2. No part of any machinery which is in motion shall be examined, lubricated, adjusted or repaired except by a person skilled for such job.
3. Machine parts shall be cleaned when such rotating machine is stop.
4. When a machine is stopped for servicing or repairs, adequate measures shall be taken to ensure that such machine does not restart inadvertently.
5. An effective guard must:
   (i) Prevent contact. The safeguard must prevent hands, arms, or any part of a worker's body or clothing from making contact with dangerous moving parts.
   (ii) Be secured & well-constructed. Workers shall not be able to easily remove or tamper with the safeguard. They must be firmly secured to the machine. Guards shall be made of durable material that will withstand the conditions of normal use. They may be constructed of sheet metal, screen, wire cloth, bars, plastic, or any other material that is substantial enough to withstand whatever impact it may receive and to endure prolonged use.
   (iii) Protect from falling objects/contain the hazard. The safeguard shall ensure that no objects can fall into moving parts.
   (iv) Create no new hazards. A safeguard defeats its own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration or creates a pinch point between the guard and moving machine parts. The edges of guards, for instance, shall be rolled or bolted in such a way that they eliminate sharp edges.
   (v) Create no interference. Any safeguard which impedes a worker from performing the job quickly and comfortably might soon be overridden or disregarded. Proper safeguarding can actually enhance efficiency since it can relieve the worker's apprehensions about injury.
   (vi) Allow safe lubrication. If possible, one shall be able to lubricate the machine without removing the safeguards.

## CHAPTER 33: SAFETY IN MATERIAL HANDLING

### A. General:

1. All materials shall be stacked, racked in an orderly manner to avoid obstruction of any passageway at the place of work. Piles of materials shall be stored or stacked in such a manner as to ensure their stability.
2. Material or equipment shall not be stored upon any floor or platform in such quantity as to exceed its safe carrying capacity.
3. Aisles and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or persons.
4. Bricks stacks shall not be more than 2.2 m in height.
5. When masonry blocks are stacked higher than 2 m, the stack shall be tapered back on half block per tier above the 2 m level.
6. Where stacking, unstacking, stowing or unstowing of construction material or article, or handling in connection therewith cannot be safely carried out unaided, reasonable measures to guard against accident or dangerous occurrences shall be taken by shoring or otherwise to prevent any danger likely to be caused by such handling.
7. Stacking of material or article shall be made on firm foundation not liable to settle and deviate such material or article and shall not overload the floor on which such stacking is made.
8. The material or articles shall not be stacked against partition or walls of a warehouse or stores unless it is known that such partition or the wall is of sufficient strength to withstand the pressure of such materials or articles.
9. The materials or articles shall not be stacked to such a height and in such a manner as would render the pile of such stack unstable and cause hazards to the workers or the public in general.
10. Where the workers are working on stack exceeding 1.5 meters in height, safe means of access to the stack shall be provided.
11. All stacking or unshackling operations shall be performed under the supervision of a responsible person for such stacking or unstacking.
12. The stacking of construction materials or articles shall not be made near the site of excavation, shaft, pit or any other such opening.
13. Stacks that may lean heavily or become unstable or collapse shall be barricaded.
14. Structural steel, poles, pipe, bar stock and other cylindrical materials, unless racked, shall be stacked and blocked so as to prevent sliding, spreading or tilting.
15. The cement or other material in bags shall be stacked in a pile in not more than 10 numbers in height unless such stack pile is stacked in a suitable enclosure or otherwise adequately supported.
16. While removing bags from the stack pile, the stability of such stack pile shall be ensured.
17. Bags containing cement or lime shall be stored in dry places.
18. The materials like bricks, tiles or blocks shall be stored on a firm ground.
19. Reinforcing steel shall be stored according to its shape, size and length and shall be kept as low as possible.
20. No pipe shall be stored on rack or in stack where such pipe is likely to fall by rolling.
21. The angle of repose shall be maintained where loose materials are stacked.
22. When dust laden material are to be stored or handled, measures shall be taken to suppress the dust produced by such storing or handling and suitable personal protective equipment shall be supplied to and used by the workers working for such storing or handling.
23. Debris shall be handled and disposed of by a method which does not cause danger to the safety of a person and not allowed to accumulate so as to constitute a hazard.
24. Debris shall be kept sufficiently moist to bring down the dust under control.
25. Debris shall not throw inside or outside from any height of building or construction work.
26. Leftover building material, article or other substance or debris shall be disposed off as soon as possible to avoid any hazard to any traffic or person.

27. Runway and ramp shall be of sound construction, strength and are securely braced and supported.
28. Runway or ramp provided for use of
    (i) workers shall not less than 500 milimetres in width,
    (ii) transport equipment like trailers, trucks or heavier vehicles shall not less than 3.70 metres in width, and
    (iii) wheel barrows, handcarts or hand trucks shall not less than 1.0 metre in width.
29. Runway or ramp located more than 3.0 metres above the floor or ground is on open sides provided with a guard rail of adequate strength and height of not less than 1.0 metre.
30. Gas cylinders shall not be lifted on bare slings. For lifting the cylinders, cage of suitable size shall be used and all cylinders shall be horizontally positioned in it. Such cage shall have fencing in such a way that there is no possibility of fall of cylinders from this cage.
31. Rigging equipment for material handling shall be inspected prior to use in each shift as necessary during its use to ensure that it is safe. Defective rigging equipment shall be removed from service.
32. Rigging equipment shall not be loaded in excess of its recommended safe working load, as prescribed in the Indian standards.
33. Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to persons engaged in the area.
34. Special custom designed grabs, hooks, clamps, or other lifting accessories, for such units as modular panels, prefabricated structures and similar materials, shall be marked to indicate the safe working loads shall be proof tested prior to use 125% of their rated load.
35. Welded alloy steel chain slings shall have permanently affixed-durable identification standing size, grade, rated capacity and manufacturer.
36. Unsafe tools, electrical cords and rigging equipment shall be tagged “Defective - Do Not Use” and shall be repaired prior to reuse or discarded.
37. Tools, electrical cords, welding leads, and rigging equipment shall be thoroughly inspected and tested as appropriate on a quarterly basis. Inspection shall be documented using tags, color codes, logs, or other means to indicate that equipment has been inspected.

**B. The stacking, storage and handling of materials generally used in for construction works shall conform to the following guidelines:**

**a) Timber:**

1. Timber shall be stacked on unyielding and level tonnage. Cross strips or cross piling shall be used where the pile is more than 1m high.
2. The top of each pile shall be kept as level as possible when timber is being removed.
3. No nails shall be allowed to protrude so as to cause any injury.
4. At least two men shall carry long boards, and care shall be exercised at corners and crosswalks.

**b) Cement:**

1. Workmen, handling bulk cement, Shall wear protective clothing, respirators and goggles, Shall be instructed the need of cleanliness to prevent dermatitis. Shall be provided with Barrier Cream.
2. Stacks shall not be higher than 15 bags. If the stack has to be more than 8 bags high, the bags shall be arranged in header and stretcher fashion, that is, alternate layers lengthwise and crosswise, so as to tie the piles together to lessen the danger of toppling over. Bags shall be removed uniformly from the top of the piles to avoid tipping of the stack.
3. Bulk cement stored in silos or bins may fail to feed to the ejections system. When necessary to enter a silo or bin for any purpose, the ejection system employed shall be shut down and locked out. When necessary for a workman to enter such storage area, he shall wear a lifeline, with another workman outside the silo or hopper attending the rope. Work permit system shall be implemented for carrying out this work.

**c) Sheet Glass and Fibre Glass:**

1. Glass panes used in building construction shall be stacked on edge with suitable supports.
2. Glass edges shall be covered or otherwise protected to prevent injuries to workmen passing by.
3. Waste glass pieces shall be stored or disposed of in such a manner as to avoid injuries to workmen.
4. Workmen handling glass panes, waste glass pieces and fiberglass shall be provided with suitable hand protection.
5. Holding the glass sheet under arm pit shall be prohibited.

**d) Pipe, Poles and Piles:**

1. Pipe shall be stacked on solid, level sills and contained in a manner to prevent spreading or rolling of the pile. Where high quantity storage is necessary, suitable packing shall be placed between succeeding layers to reduce the pressure and resulting spreading of the pile.
2. Heavy-duty cantilever racks can be used to allow good visibility and easy access to materials.
3. Orderly storage as to sizes and lengths enhances access and removal operations.
4. Removal of pipe from a pile shall be accomplished by working from the ends of the pipe.
5. In loading pipe or transit, it shall be so secured as to insure against displacement.
6. While handling piles or poles taglines shall be used to control movement of them.

**e) Reinforcement Steel and Structural Steel:**

1. Reinforcement steel shall be labeled and stored on firm ground according to length, size and shape, and shall be piled in such a manner as to prevent tipping or falling.
2. Steel shall be stored on a solid foundation with adequate number of wooden packing below.
3. Adequate spacing shall be maintained between piles to ensure safe access.
4. Structural steel shall be carefully piled to prevent sliding or tipping.
5. Tag lines shall be used to control the movement of the load during handling Reinforcement or structural steel when a crane is employed.
6. As far as possible, lifting and carrying of heavy materials manually shall be avoided.

**f) Handling Heavy & Long Items:**

1. Loading and unloading of heavy items shall, as far as possible, be done with cranes or gantries.
2. The workman shall stand clear of material being moved by crane.
3. The slings and the ropes used shall be of adequate load carrying capacity, so as not to give way and result in accidents.
4. Adequate safety clearance shall be maintained from overhead electrical lines.

**g) Loading and Unloading from Motor Vehicles:**

1. The motor vehicles shall be properly blocked while being loaded or unloaded; brakes alone shall not be dependent upon to hold them.
2. Ladder shall be used to climb up / down the vehicle.
3. Load on the vehicle shall be secured adequately so that the load does not slide down. If the width of the load exceeds that of the vehicle, red lights / flag shall be provided on all the corners of the vehicle to caution other vehicles on the road.
4. Unloading shall be started from top.
5. When motor vehicles are being loaded or unloaded near passageways or walkways, adequate warning signs shall be placed on each end of the Vehicle to warn pedestrians and the drivers of the other vehicles.

**h) Sand, Gravel and Crushed Stone:**

1. Stockpiles of these materials shall be so located as to provide easy access for withdrawing. In stacking these materials, adequate safety distances shall be maintained between the material and the over-head power lines. When withdrawals are made from stockpiles, no overhand shall be permitted.
2. Materials shall not be piled against walls that will be endangered by thrust, nor along the sides of any excavation or on the top of an embankment so as to cause slips.
3. Employees required to enter hoppers shall be equipped with safety belts and lifelines, attended by another person. Machine-driven hoppers, feeders, and loaders shall be locked in the off position prior to entry. Work permit system shall be implemented.

**i) Paints, Varnishes and Thinners:**

1. Paints, varnishes, thinners and other flammable materials shall be kept in properly sealed or closed containers. The containers shall be stored in a well-ventilated, free from excessive heat, smoke, sparks or flame. A separate shelter shall be provided for storing these materials.
2. Paint materials in higher quantities other than required for daily use shall be kept stocked under regular storage place.
3. Paint scrapings and paint-saturated rags and debris shall be removed daily from the premises and preferably, destroyed by burning at a safe place.
4. Ventilation adequate to prevent the accumulation of flammable vapour to hazardous levels of concentration shall be provided in all areas where painting is done. When electric lights, switches or electrical equipment are necessary, they shall be of explosion-proof design.
5. Fire Buckets and foam type shall be kept ready for use in case of fire.
6. No smoke or open fire, exposed heating elements, or other sources of ignition of any kind shall be permitted in areas or rooms where spray painting is being done.

**j) Bitumen, Bituminous Emulsion and Road Tar:**

1. No stack shall exceed 100 drums (180/200 litres). Safe distance of 6m minimum shall be kept between stacks.
2. Drums shall be kept stacked on their sides so that water does not collect on them.
3. Pyramid stacking shall always be used and the height of the stack shall not exceed 3 tiers.
4. Stack building or de-stacking shall be done only by using crane.

**k) Flammable Materials:**

1. A separate shelter shall be provided for storing flammable materials.
2. Flammable materials shall be stored in accordance with the relevant regulations and rules so as to ensure the desired safety during storage. Explosives like detonators shall be stored in accordance with the existing regulations of Indian Explosives Act.
3. Operations in connection with handling, storage and issuance of inflammable liquids shall be under the supervision of qualified and experienced persons.
4. Workmen shall be required to guard carefully against any part of their clothing becoming contaminated with flammable fluids. They shall not be allowed to continue work when their clothing becomes so contaminated.
5. Petroleum products delivered to the job site and stored there in drums shall be protected during handling to prevent loss of identification through damage to drum markings, tags, etc. Unidentifiable petroleum products may result in improper use, with possible fire hazard, damage to equipment, or operating failure.

6. Bulk delivery and storage of petroleum products requires the same care in identification, and particular attending to fire hazards during handling.
7. Outdoor storage of drums requires some care to avoid contaminations. Moisture and dirt in hydraulic brake and transmission fluid, gasoline, or lubricants may easily cause malfunction or failure of equipment, with possible danger to personnel. The storage area shall be free of accumulations of spilled products, debris and other hazards.
8. Compressed gases and petroleum products shall not be stored in same building or close to each other.
9. For bulk storage of petroleum (petrol, diesel etc.) and the like, the storage shall comply strictly with the specifications given in the Petroleum Rules (and with the relevant act).

## CHAPTER 34: SAFETY IN MANUAL MATERIAL HANDLING

### A. General:

Strains, sprains, fractures, and contusions are the common injuries in manual material handling. They are caused, primarily by unsafe work practices, such as improper lifting, carrying too heavy a load, incorrect gripping, failing to observer proper foot or hand clearances and failing to wear personal protective equipment.

Training in safe work habits, breakdown and study of even the simplest job operations, and adequate supervision can help minimize these accidents. General points that can be given to those who handle materials include: Inspect materials for jagged or sharp edges, burrs, rough or slippery surfaces. Grasp the object with a firm grip. Keep fingers away from pinch and shear points, especially when setting down materials. While handling timber, pipe or other long objects, keep hands away from the end to prevent them from being pinched. Wipe off greasy, wet, slippery or dirty objects before trying to handle them. Keep hands free of oil and grease.

In most cases, gloves, or other hand protectors shall be used to prevent hand injuries. In other cases, handles or holders can be attached to objects, such as handles for moving auto batteries, tongs for feeding materials to metal-forming machinery or baskets for carrying laboratory samples. Feet and legs sustain a major portion of material handling injuries - the greater percentage occurring to the feet. Workers shall be instructed to wear foot protection such as safety shoes. The eyes, head and trunk of a body can also be injured. When opening a wire-bound or metal bound bale of box, a person shall wear eye protection equipped with side shields as well as stout gloves, and take special care to prevent the ends of the bindings from flying loose and striking the face or body. The same precaution applies to handling coils or wire, strapping, or cable. In many cases, special tools are available to safely cut bands, strapping, and the like. Workers shall always read the labels on packages for special instructions. If material is dusty or is toxic, the person handling it shall wear a respirator or other suitable personal protective equipment. Mechanical movement of materials shall be used so far as possible. When a worker lifts a heavy or bulky object and carries it to another location, the route over which the object is moved shall be inspected beforehand to make sure that there are no obstructions or spills that could cause slipping or tripping injuries. If clearance is not adequate for handling the load, then an alternate route shall be taken. The object may have to be turned over before attempting to lift it. Also, if the object is wet or greasy, it shall be wiped dry so that it will not slip. If this is not practical, the worker shall use a rope sling or other device that will give a positive grip.

The correct applications of basic factors for manual material handling are essential. Correct position of feet, straight back, bent knees, load held close to the body, firm grip, chin-in, use body weight.

When a gang of worker carries a heavy object such as a rail, the supervisor shall make sure that proper tools are used.

No person shall be allowed to lift, put down, carry or move any load of material, article, tools or appliance exceeding the max. limit in weight, as mentioned in the statute.

**B. Handling of some specific item:**

a) **Handling of Specific Shaped Boxes, Cartons, and Sacks**: The best way to handle box and cartoon is to grasp the alternate top and bottom corners and to draw a corner between the legs. Sack materials are also grasped at opposite corners. Upon reaching an erect position, the worker shall let the sack rest against his hip and belly and then swing the sack to one shaller. As the sack reaches his shaller, he shall stoop slightly and put his hand on his hip, so that the sack rests partly on the shaller and partly on the arm and back. The other hand shall be holding the sack at the front corner. When the sack is put down, it shall be swung slowly from the shaller until it rests against the hip and belly. While the sack is being lowered the legs shall be flexed and the back kept straight.

b) **Barrels and drums**: Those who handle heavy barrels and drums require special training. A barrel is generally less hazardous to handle than a drum because the shape of the barrel aids in unbending it. Since the weight and contents of a barrel or drum may vary greatly, special attention shall be given to these factors. Frequently, only one person is available to handle a drum, in which case it is better to wait for help or use mechanical assistance. A commercially available drum tilter equipped with wheels is commonly used. An extension handle provides control and leverage during the tilting operation. The wheels allow the tilted drum to be transported short distances more readily. Another commercial device is a two-wheeled trolley equipped with large rubber tyres that is gaining popularity due to the ease of tilting and transporting. If it is necessary to roll a barrel or drum, the worker shall push against the sides with the hands. To change direction of the roll, he shall grip the chime rather than kick the drum. A clamp device for carrying a drum is available. To lower a drum or barrel down a skid, the drum shall be turned and slid endwise. Rolling a drum or barrel up a skid takes two persons, who shall stand outside the skid, neither inside the rails nor below the drum or barrel being raised or lowered. If drums or barrels are to be handled on an incline or skid, ropes or other tackle shall be used to control their motion. The drum or barrel shall be snubbed with a rope, one end of which is securely fastened to the platform from which the drum or barrel is to be lowered. The rope shall then be passed around the barrel or drum, and the operator, keeping a firm grip on the free end, can gradually lower the load.

c) **Sheet metal:** Sheet metal usually has sharp edges and corners and shall be handled with leather gloves, or gloves with metal inserts. Gauntlet-type gloves or wristlets will give added protection to wrist and forearm. Bundles of sheet metal shall be handled with power equipment.

d) **Flat glass:** Flat glass shall be handled by persons equipped with gloves or hand laps, wrists and arms shall be protected with leather cuffs and safety sleeves. The worker shall wear a leather apron, leggings, and safety shoes. Unless the glass plates are small, the worker shall carry only one at a time and walk with care. The plate shall be lifted carefully and carried with its bottom edge resting in the palm (turned outward) and the other hand holding the top edge to steady it. Glass plate shall never be carried under the arm because a fall might break the glass and severe an artery. To transport larger glass plates over any distance, handling equipment shall be used. Larger flat glass shall be handled by equipment specifically designed for that purpose. Equipment such as cranes equipped with vacuum frames. C-frames or spreader bars, and special wagons etc. are normally used to transport heavy glass. If large plates must be transported by hand, two workers wearing safety hats, safety sleeves, cuffs, gloves, and safety shoes shall be assigned to the job.

e) **Long objects**: Long pieces of pipe, bar stock, or lumber shall be carried on shaller, with the front end held as high as possible to prevent striking other employees, especially when going around corner. Workers shall wear shaller pads for this operation.

f) **Irregular objects**: Presents special problems. Often the object must be turned over or up on end, so that the best possible grip can be secured. If the worker questions his ability to handle the object, because of either its weight or shape, he shall get help.

g) **Scrap Metals**: In a scrap storage area, the best possible housekeeping practices shall be observed irregularly shaped jagged pieces may be tangled in such a way that strips or pieces may not fly when a piece is removed from a pile. Workers, therefore, shall be provided with goggles, leather gloves or

mittens, safety hoe, safety hats and protection for the legs and body. Workers shall be cautioned against stepping on objects that may roll or slide.

**h) Heavy, round flats, objects**: Can be rolled by hand only with considerable skilled personnel. The operation required careful training and exacting precautions. It is preferable to use hand truck or power equipment designed for the purpose.

## CHAPTER 35: HANDLING OF OIL AND GREASE

1. All electrical safety measures shall be followed strictly to prevent spark in oil storage & handling area.
2. Smoking shall be strictly prohibited in oil storage & handling area.
3. Open flamed lighting arrangement shall not be allowed in oil storage & handling area.
4. Flameproof lighting arrangement shall be provided in oil storage & handling area.
5. Oil containers shall be stored in upright position unless otherwise specifically mentioned and on a cemented floor with collection pit.
6. Oil storage area shall be away from other establishment and securely protected.
7. Caution sign board shall be displayed at oil storage area with caption “NO SMOKING”, “NO OPEN FLAMMED LIGHT”, “FLAMMABLE LIQUID” etc.
8. Never heat a container that has stored oil without first ensuring that it is free of residual oil and oil vapour.
9. To extinguish a small fire, foam, dry powder or $CO_2$ extinguisher or earth/sand can be used. DO NOT USE WATER ON AN OIL FIRE AS IT WILL CAUSE THE FIRE TO SPREAD.
10. Avoid prolonged or repeated exposure of skin to contact with oil and avoid splashing it into the eyes, swallowing it, or inhaling the vapour in a confined space. In the event of contact with skin, wash with large volumes of water; for contact with the eyes, bathe them with clean water for ten minutes and seek medical attention if irritation persists.
11. Materials contaminated with oil shall not be carried, or left in pockets, and any clothing that is heavily contaminated shall be changed as soon as practicable.
12. Do not deliberately drink or inhale petroleum products but if this shall happen accidentally, seek urgent medical attention.
13. Availability & use of appropriate pumps / transfer equipment for the transfer of spilled oil shall be ensured.
14. Ensure the availability of separate measuring cans of different capacities and funnels for the issue of the various grades of oils.
15. Separate jerry cans for intermediate storage of oil, if replaced, shall be used. These cans shall be kept in trays with proper identification and pumps shall be used to draw out required quantity of oil into handy container. Ensure the containers are having lid to avoid spillage during handling.
16. Top up oil using correct sized funnels.
17. Rejected oil from equipment shall be collected to avoid spillage using proper device (funnel, tray, and containers). Collected oil shall be transferred to site at identified locations. The filled drums shall be returned to store for further disposal action. Ensure that the waste oil collected is sold to authorized recycles (By Central Pollution Control Board) and records to be maintained as per Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules.
18. The fresh left over oil shall be kept/poured back into the respective containers kept in the maintenance section / sub store-using funnel to avoid spillage.
19. Placement of oil drums, cans in tray shall be so ensured to facilitate collection of spilled over oils is easy.
20. In case of any spillage of oil, wipe with waste cotton / jute & throw it in the designated bin.

21. In the event of a spillage or leakage, do not smoke in the vicinity and do not try to disperse the oil with water; under no circumstances shall a petroleum product be allowed to enter a drain or watercourse.
22. Keep the records of the oil issued / returned.
23. Oil products shall be stored in a soundly constructed tank, designed specifically for the purpose, and shall be sited away from any source of heat or potential ignition.
24. A means, such as drip-tray or control pallet shall ideally be provided, capable of containing any oil that may leak or spill from the tank.
25. There shall be suitable and unobstructed access at ground level to the tank and/or its fill point.
26. The tank shall be clearly marked with the grade of oil required and the tank's total capacity. An accurate gauge or dipstick shall be fitted to the tank to avoid overfilling. The tank and its associated equipment shall be examined carefully before and after a delivery and if there is a problem, such as a spillage or leakage, this must be notified to the oil supplier as soon as possible.

## CHAPTER 36: HANDLING AND STORAGE OF CYLINDERS CONTAINING FLAMMABLE GASES AND LIQUIDS AND SAFETY REQUIREMENT FOR STORAGE TANK

Flammable Gases and flammable liquids play a vital role in the construction, installation, erection and operation and maintenance of plant. Their improper use may result in loss of life by fire and explosion. Gases for cutting, welding, etc. and flammable liquids like petrol, diesel, kerosene and various hydrocarbons and chemicals like sulphuric acid, hydrochloric acid and nitric acid, and chemical compounds like calcium carbide, acetone, air-entraining agents, epoxy, paints, polishes, varnishes etc., are also used in the plant. It is essential to take necessary precautions in storage, transportation, handling and use of these gases and hazardous substances. Flammable liquids vapourise and form flammable mixtures when kept in open containers, when leaks or spills occur or when they are heated. The degree of danger is determined by the flash point of the liquid, concentration of the vapour in the air (whether the vapour-air mixture is in the flammable range or not) and possibility of a source of ignition at or above a temperature sufficient to cause the mixture to burst in to flame. In the handling and use of flammable liquids, exposure of large liquid surfaces to air shall be prevented. Liquids themselves do not burn or explode, but the vapour-air mixtures, formed when they evaporate are explosive. Therefore, handling and storing of these liquids in closed containers and avoiding exposure of low flash point liquids in use are of fundamental importance. As a safeguard against explosions, tests shall be carried out for presence of flammable mixture in the containers. During construction of various underground works of river valley projects, it shall be ensured that the workers employed in the confined space are not exposed to risk due to presence of insufficient oxygen or flammable liquids/dangerous gases. The tests shall also be carried out for presence of various flammable liquids/dangerous gases, so as to ensure safety during working in the vicinity. In case, the presence of dangerous gases/flammable liquids is indicated, safety measures shall be adopted immediately so as to avoid major mishap. The presence of vapours or fumes of dangerous gases shall be detected by the instruments in accordance with the relevant Indian Standards.

### A. General safety measures:

1. Whenever the percentage of dangerous gases/flammable vapours is indicated in a working area /vessel, above the permissible proportions, all the persons working in the area shall be withdrawn and electricity cut off from the main source outside the tunnel.
2. If there is any possibility of presence of dangerous gases/flammable vapours, while doing underground works/tunneling, only permitted explosives and approved type exploders (as advised by the dealers) shall be used and flame-proof electric equipment and lights (as details in Electricity Rules) shall be installed so as to avoid sparking from loose connections. Lights shall be kept sufficiently away from the working faces. The battery operated machinery also be a source of ignition.
3. Smoking and carrying of naked fires, matches, lighters or other spark-producing device is prohibited in

the area where flammable liquids/dangerous gases are stored, handled or used.

4. In case, the presence of dangerous gases/vapours is indicated, the same shall not be brushed of wafted by any means and steps shall be taken to remove the gas by improving the ventilation after rendering it harmless by dilution through supply of air, if necessary.
5. The working area shall be examined for dangerous gases within 2 hours before the beginning and at least after every 2 hours during the working shift.
6. The work shall be restarted only after ensuring the accumulation of gases to be less than permissible proportions.
7. To eliminate a spark from discharge of static electricity during filling operations proper bonding & grounding shall be ensured to all containers.
8. Preventing dangerous mixtures - Accidental mixing of flammable liquids shall be prevented; for example, gasoline mixed with fuel oil may change the flash point sufficiently to make the fuel hazardous in ordinary use. If a worker has been exposed to dangerous gases like carbon monoxide or methane emanating from some hidden source in underground excavations, he shall be at once removed to an uncontaminated area.
9. Under no circumstances shall a rescuer enter the site of excavation to remove a victim of over exposure without proper respiratory protection.
10. If breathing has stopped, an effective means of artificial respiration shall be started immediately. If oxygen inhalation apparatus is available, oxygen shall be administered but only by a person authorized for such duty or by a physician.
11. The patient shall be kept warm but not hot.
12. Procedure as per Emergency Management Plan shall be followed for summoning ambulance, physician or other agency promptly, so that such assistance will be enroute to the location before the rescue is accomplished.
13. Oxygen content of the atmosphere in the confined space shall be determined by pre-entry and subsequent tests made with approved instruments.
14. No one shall enter or remain in a confined space where tests show less than 19.5 percent oxygen in its atmosphere or show presence of dangerous gases, unless he wears approved respiratory protective equipment such as a fresh-air hose mask or self-contained breathing apparatus conforming to IS: 8523(specification for respirators, canister type gas masks).

**B. Safety aspects in storage, handling and use of such gases:**

**a) Storage:**

Compressed gases are usually contained in cylinders of different shapes and sizes. Gas cylinders are painted in different colours according to the contained gases to make the identification easier. Following safety measures shall be observed in the storage of cylinders:

1. Gas cylinders stores shall be well-ventilated and empty cylinders shall be stacked away from full cylinders.
2. Empty cylinders shall be segregated from the filled ones and care shall be taken that all the valves are tightly shut. 'Full' or 'Empty' notices shall be displayed on each relevant stack.
3. When stacking the cylinders vertically, it shall be ensured that they are properly secured by suitable brackets or stands so that they do not fall.
4. If cylinders are stacked horizontally, proper blocks shall be used at each end of stack to prevent their rolling. Large size cylinders shall be placed at the bottom. One vertical stack shall not contain more than four cylinders.
5. It shall always be ensured that the cylinders are protected from corrosive conditions.

6. It shall be ensured that cylinders do not come in contact with electrical apparatus or live wire.
7. Cylinders shall not be directly placed on wet soil. Proper dunnage shall be used.
8. Cylinders shall be stored away from sources of heat.
9. Cylinders shall not be exposed to direct rays of the sun. Tarpaulin or any other cover shall not be used in direct contact with cylinders, as a protection against the sun.
10. Under no circumstances shall a cylinder used for storing one type of gas be used for storing another
11. type. This is of paramount importance with such gases as oxygen on one hand and hydrogen or acetylene on the other. Mixing up of such gases would produce serious explosion risk.
12. Ensure that there is no other inflammable material stored near the Compressed Gas Cylinders.
13. Ensure that nobody smokes and carries the matchbox in compressed gas storage area.
14. The storage room or shed shall be of fire resistant construction.
15. The gas cylinder is painted with appropriate identification colours specified in IS: 4379 for industrial cylinders & IS: 3933 for medical cylinders. Display boards of colour coding of gas cylinders.
16. Do not change the colour of this cylinder.
17. This cylinder should not be filled with any gas other than the one it now contains.
18. No flammable material should be stored in the close vicinity of this cylinder or in the same room in which it is kept.
19. No oil or similar lubricant should be used on the valves or other fittings of this cylinder.
20. Please look for the next date of test, which is marked on a metal ring inserted between the valve & the neck of the cylinder, & if this date is over, do not accept the cylinder for use.
21. The storage room or shed shall be of fire resistant construction.
22. Cylinders containing flammable gases & toxic gases shall be kept separated from each other & from cylinders containing other types of gases by an adequate distance or by a suitable partition wall.
23. Cylinders shall not be stored under conditions, which will cause them to corrode.
24. Cylinders shall not be stored along with any combustible material.
25. In premises for filling & storing flammable gases in cylinders all electric meters, distribution boards, switches, fuses, plugs & sockets, electric fittings, fixed lamps, portable hand lamps & motors, shall be of flame proof construction conforming to IS:2148 or such other specification as approved by the Chief Controller & shall be effectively earthed.
26. Before accepting the gas cylinder from vendor check whether they are tested as per the gas cylinder rules.

**b) Handling:**

Following safety measures shall be observed in handling of cylinders:

1. Oil and grease ignite violently in presence of oxygen and may even lead to explosion in case oxygen is under pressure. Oxygen cylinders shall be kept away from oil soaked debris, rags, etc.
2. It shall be ensured that grit, oil dirt of any sort does not enter regulator assemblies.
3. Only the standard key shall be used for opening the valves and the key shall be free from any oil or grease. Leverage of keys or spanners shall not be increased and no attempt shall be made to get gas from cylinders with broken valves thereby rendering the cylinder useless.
4. Cylinder shall not be used as rollers, work supports or jacks.

5. Trolleys & cradles of adequate strength shall, as far as possible, be used when moving the cylinders.
6. The cylinders shall be handled carefully & not be allowed to fall upon one another or otherwise subjected to any undue shock.
7. Sliding, dropping or playing with cylinders is prohibited.
8. Open flames, lights, mobile phones, lighting of fires, welding and smoking shall be prohibited in close proximity to any cylinder containing flammable gases except those while in use for welding, cutting or heating.
9. Display no smoking

**c) Loading and unloading for transport**

1. Cylinders shall not to be transported by a bicycle or any other two-wheeled, mechanically-propelled vehicle
2. There shall be no sharp projections on the inside of the vehicle
3. Cylinders shall be adequately secured to prevent their falling off the vehicle & and being subjected to rough handling, excessive shocks or local stresses
4. For lifting operation is carried on by means of a crane or a fork-lift truck, a proper cradle with chains or wire rope slings shall be used.
5. Cylinders transported in vehicles shall be blocked or braced & be so secured to prevent movement, striking each other or falling down.
6. Cylinders filled with any compressed gas shall not be transported along with any other article of a highly flammable or corrosive nature.
7. Flammable gas cylinders not to be transported with gas cylinders containing any other gas
8. Toxic or corrosive gas cylinders not to be transported along with any foodstuff
9. Gas cylinder valve to be protected during transportation
10. Cylinders containing flammable gases shall not be transported along with the cylinders containing any other type of compressed gas
11. No lifting magnet shall be used in loading or unloading of cylinders filled with any compressed gas.
12. Any cylinder containing a flammable or toxic gas, which develops a leak during transport, shall promptly be removed to an isolated open place away from any source of ignition and the person responsible for transportation shall immediately contact the filler or the consignor as the case may be, for necessary advice.
13. Cylinders shall not be loaded loosely in a vehicle as these will come in contact with each other and be subjected to jolting and damage during vehicle movement.
14. Cylinders shall be kept away from sparks, flames or slag from welding and cutting operations.
15. Cylinders, which get damaged in transit or in the course of being used in the plant or for any other course, shall be handled in the same manner as leaking cylinders.
16. Handling of acetylene cylinders needs special attention, as acetylene is a highly flammable gas and in case it leaks, the acetylene-air mixture is likely to explode if ignited by flame, heat or spark present in the vicinity. Acetylene cylinders shall, therefore, be handled very carefully to prevent damage, which might lead to bursting of cylinders or leakage through the cylinder valve. They shall not be banged, jolted violently, dropped or thrown about.
17. When being unloaded from a truck, the cylinder shall be lowered gently. They shall not be dropped or allowed to strike against each other. The following method of unloading gas cylinders from road vehicles or railway wagon is recommended:

    (i) Whenever possible, the cylinder shall be unloaded directly on a raised platform by rolling over a coir mattress.
    (ii) If a suitable raised platform is not available, each cylinder shall be slide down over a heavily reinforced 15 cm thick coir mattress of about 2m x 1m size taking care that the

bottom end touches the mattress first and then it is rolled away over the mattress. Cylinders shall not be dropped from a height.

(iii) It shall be ensured that the first cylinder has rolled away before the next one is slide down.

(iv) Lifting magnet shall not be used for loading and unloading.

(v) A fibre rope sling may be used to lift one cylinder but not more than one at a time, provided it is adequately strong and correctly adjusted to prevent slipping. Use of a chain sling is unsafe, as it is very likely to slip, over a cylinder.

(vi) From the unloading platform to the storehouse or from storehouse to the plant, the cylinders shall be transported by means of a handcart. Such a handcart shall be provided with a chain or belt for securing the cylinders in proper position.

(vii) If a cylinder is to be transported over a short distance and a suitable hand-cart is not available; it shall be rolled over its bottom edge but never dragged.

18. The cylinders containing compressed flammable gas shall:
    (i) be checked externally for damages.
    (ii) be checked and tighten the regulating valve of the cylinder before unloading. Unloading only is done in case there is no leakage.
    (iii) never roll the cylinders on the ground.
    (iv) confirmed of possible gas leakage to be checked by identifying the hissing sound in the gas system.
    (v) in case of any doubt of gas leakage, soapy water to be applied in the gas system for further confirmation.
    (vi) not change the color of the cylinder.
    (vii) not be filled with any other gas other than the one it now contains.
    (viii) not be used oil or similar lubricant in the valves or other fittings of the cylinder.
    (ix) checked for the next date of testing which is marked on a metal ring inserted between the valve and the neck of the cylinder and if this date is over ,do not accept the cylinder.
    (x) be inspected, stored, handled and transported in conformity with the requirements of Gas Cylinders Rules, 1981.
19. When in use, cylinders shall be held in upright positions by straps, collars or chains.
20. Arrangement during storage & use shall be such that the cylinders can be rapidly removed in an emergency.
21. Cylinder together with the valve and fittings and identification colour always be maintained in good condition.
22. No cylinder shall be subjected to any heat treatment or exposed to a high temperature or to the sun.
23. Every cylinder containing compressed Gas shall have the valves securely closed so as to prevent leakage. Valves of the cylinder containing LPG and highly toxic gases like Boron, Triflouride, Hydrogen Sulphide, Methyle Bromide, Nitrogen Tetroxide, Chlorine, Ammonia or Sulphur Dioxide shall be provided with security nut at the outlet to act as a secondary.
24 Switch off the knob of the cylinder when the gas is not in use for a long time.
25. Ensure that there is no loose wiring in that area.
26. Compressed gas cylinders shall not be exposed to temperatures exceeding 125 degree F (50 degree C).
27. Check for the next date of testing which is marked on a metal ring inserted between the valve and the neck of the cylinder and if this date is over, do not accept the cylinder.
28. Leaky cylinders charged with acetylene or liquefied fuel gas shall be taken into the open air at a safe distance from any open flame or sparks.
29. Gas cylinders shall always be kept in upright position.
30. Every cylinder shall be labeled with the name of the gas and the name and address of the person by whom the cylinder was filled with gas.

31. Conveyors, trolleys and cradles of adequate strength shall, as far as possible, be used when moving the cylinders.
32. The cylinders shall be handled carefully and not be allowed to fall upon one another or otherwise subjected to any undue shock.
33. Sliding, dropping or playing with cylinders is prohibited.
34. Cylinders shall be stored in a cool, dry, well ventilated place under cover, away from boilers, open flames, steam pipes or any potential sources of heat and such place of storage shall be easily accessible.
35. Thin wall cylinders such as liquefied petroleum gas cylinders and dissolved gas cylinders shall not be stacked in a horizontal position.
36. Cylinders containing flammable gases and toxic gases shall be kept separated from each other and from cylinders containing other types of gases by an adequate distance or by a suitable partition wall.
37. Cylinders shall not be stored along with any combustible material.
38. In premises for filling and storing flammable gases in cylinders all electric meters, distribution boards, switches, fuses, plugs and sockets, all electric fittings, fixed lamps, portable hand lamps and motors, shall be of flame proof construction.
39. A cylinder exposed to fire shall not be used unless it has undergone proper examination and hydrostatic test or hydrostatic stretch test. If deleterious structural changes in the material due to the action of heat of the fire are apprehended to have taken place, the cylinder shall have to be subjected to proper heat treatment, followed by hydrostatic test or hydrostatic stretch test, as the case may be, before the cylinder is taken into use.
40. Dissolved acetylene cylinders, which have been damaged by fire shall be condemned and destroyed by an experienced and competent person.
41. No person shall fill any cylinder with any compressed gas unless the cylinder has been examined and subjected to hydrostatic test or hydrostatic stretch test.
42. Any cylinder which fails to pass periodic examination or test or which loses in its tare weight by over 5 per cent or which for any other defect is found to be unsafe for use or after expiry of the service life of the cylinder, shall not be filled with any compressed gas and shall be destroyed by flattening it as a whole or after being cut into pieces in such a manner that the pieces cannot again be joined together by welding or otherwise to form a cylinder, under intimation to the owner of the cylinder.

## SAFETY REQUIREMENTS FOR STORAGE TANK

The followings are the requirement for safety of Storage Tank:

1. The storage tank area should have sufficient ventilation.
2. There should be arrangement for indicating safe level (both high and low) inside the tank with alarm system.
3. Stand by arrangement equal to the bigger container shall always be available to transfer the hazardous chemicals/substances in case of leakage.
4. Every storage tank containing hazardous substances shall be covered properly.
5. Smoking, carrying matches etc. are prohibited in flammable storage tank area.
6. An adequate number of fire extinguishers of suitable type should be kept in the storage tank area.
7. The capacity in liters and the name of the product shall be conspicuously marked on the tank.

8. All storage tank of petroleum product shall be constructed of iron or steel as per IS specification.

9. Every tank containing petroleum in bulk should be electrically with the earth at least by two separate connection and the resistances to earth should not exceed 7 ohms.

10. Air space of al least 5% of the total capacity for bulk petroleum storage should be provided.

11. Storage tank after installation or after any major repair should be tested by water or other fluid before being put in use.

12. All bunds/enclosure surrounding above ground tank shall be provided with proper drainage facilities so that there is no accumulation of water.

13. The protected area surrounding storage tank shall be fenced. The area shall be kept clean and no dry grass, plant etc. should be there for avoiding fire.

## CHAPTER 37: HANDLING OF CHEMICALS

1. While purchasing chemicals, mention in the purchase order that the Supplier / Transporter shall ensure proper displays regarding any hazard(s) and handling instruction(s).
2. While receiving chemical containers, check for damages -if found, transfer the contents immediately in a fresh container.
3. Study the Material Safety Data Sheet (MSDS) and store in conditions mentioned. Train the personnel handling the same on the MSDS; also ensure displays as may be required.
4. Do not store incompatible chemicals near each other.
5. Use appropriate Personal Protective Equipment e.g., gloves, boots, masks etc. - as mentioned in the MSDS.
6. There shall not be any sources of heat or electricity near the storage location.
7. While transferring chemicals, check that there is no spillage - if spillage occurs, wipe clean with cloth and out in designated bin.
8. If chemicals are stored for a long period, check for leakage from time to time.
9. In case of fire, remove all flammable materials nearby to the extent possible; use foam type fire extinguisher.

## CHAPTER 38: PREVENTION OF OIL LEAKAGE, SPILLAGE

1. Centrifuging of all the oils.
2. Annual checks of the oil by reputed firm.
3. Check OPU manifold blocks for oil leakage through couplings.
4. Check all the bearing housings of abnormal oil level & leakage of oil.
5. Check oil leakage from turbine & MIV Servomotors; change the seals to avoid leakage.
6. Check oil leakage from bearing housing oil cooler.
7. Check oil level of LGB housing from oil level gauge.
8. Check oil leakage from transformers.
9. Check leakage of oil from chiller compressor.
10. Control oil spills during manual handling, topping up, manual transfer / pumping.
11. Check oil drums / containers for leaks.
12. In case of any leaks/spills, transfer re-usable oil in another container, soak the rest spill / leak with saw dust / jute / cloth and throw in designated bin.

## CHAPTER 39: PROTECTIONS AGAINST HAZARDOUS CHEMICALS/GASES AND SAFETY INSTRUCTION IN CASE OF CHLORINE LEAKAGE

### A. General:

1. Gas masks shall be provided in accordance with the requirements of IE Rules, 1956.
2. For each chemical used, manufacturer's instructions for use, storage, labeling, disposal and for dealing with emergencies arising from it use shall be duly followed.
3. Solvents, cleaners and degreases shall be used only in well-ventilated areas.
4. Smoking and other ignition source shall be kept away from inflammable materials.
5. Each MSDS shall be reviewed prior to brining the material on site.
6. All chemical containers that are stored and used at the site must be labeled. Labels must not be removed or defaced.
7. An up to date site chemical inventory shall be maintained by the responsible person.
8. Chemicals transferred into secondary containers for use must be labeled or marked with the following information:
   (i) Identity of the Hazardous Chemical,
   (ii) MSDS Hazard symbol or descriptive text in local language(s)

### B. Use, store, handle and dispose of hazardous materials:

Use, store, handle and dispose of hazardous materials shall be in accordance with applicable law/requirements and in a manner that will not cause harm to personnel and the environment. The following storage and handling practices shall be followed:

1. Hazardous Chemicals and oils received at the Site must be immediately moved to their designated storage area.
2. All storage areas shall be provided with containment and protected from the elements using a roof, tarp, or approved hazardous material storage cabinet.
3. Storage areas shall be surrounded by a berm or dike to contain any possible spill.
4. The ground area inside the dike shall be protected by concreting.
5. Storage of liquids in bulk tanks and/or barrels shall be in level storage areas and away from the proximity of natural watercourses, or wetlands.

6. Above ground fuel and oil storage tanks shall be checked for leakage and spillage on a daily basis.
7. Combustible Materials are not permitted to be stored inside Flammable Storage area.
8. Where practical, chemicals shall be stored at or below eye level.
9. Chemicals must be segregated by their hazard characteristics, classification, and compatibility. The area will be well defined and labeled.
10. When chemicals are transported by hand they will be transported in covered containers.
11. Storage of chemicals at the point of use will be limited to those amounts necessary for one operation or shift.
12. Containers in-use will be properly labeled and of minimum size.
13. Additional storage requirements apply for certain classes of chemicals and for chemicals that are incompatible with other chemicals.
14. All chemical storage must be reviewed by a competent person for compliance with applicable standards and precautions.
15. Provisions shall be made to prevent the release of hazardous materials and petroleum products to the environment including but not limited to the following: Drip pans, oil absorbents and pigs shall be used as appropriate during material transfer operations.
16. Oil transfers will be monitored to insure that all hose connections are in good repair and not leaking.
17. Equipment, which uses hydraulic or lube oils shall be maintained in a manner, which prevents leaks.
18. Any equipment, which is leaking, shall be repaired or removed from service.

## SAFETY INSTRUCTION IN CASE OF CHLORINE LEAKAGE

- Do not panic.
- When chlorine leakage occurs in liquid phase the toner should be rotated so that only chlorine gas escapes from leaking point.
- Water should not be sprayed on a chlorine leakage container.
- Liquid spilled chlorine should be covered with sand or earth.
- The operator should switch on the caustic re-circulation pump and chlorine blower.
- Leaking toner should be covered with hood.
- In case of fire in chlorination plant, cylinder / toner should be removed to a safe place.
- Make it habit to use P.P.E, like PVC gloves, gumboots, rubber overcoat / apron, gas mask while working in chlorine operations.
- Never attend the leakage without using breathing apparatus (B.A. Set).
- In case of heavy leakage of chlorine gas the following steps may be followed:

  (a) Persons in the path of gas should be warned or evacuated if necessary.

  (b) Persons should move opposite to the wind direction or in the direction perpendicular to wind direction.

  (c) In case evacuation is not possible, close all the doors & windows of the house and move to the upper stories.

  (d) Cover the face with a wet towel.

- **First Aid**

**I.** <u>If inhaled:</u>

a) Remove the patient immediately from the contaminated area to a fresh air area.
b) Call the doctor for appropriate treatment.
c) Never give anything by mouth to an unconscious person.

**II**. <u>In case of skin absorption:</u>

a) Get the victim, clothes and all under a shower immediately and remove clothing while shower is running.

b) Wash the skin or contaminated area with large amount of water.

**III**. <u>In case of eye contaction:</u>

a) Flush the eyes immediately with Luke warm water for at least 15 minutes.
b) Hold the eyelid apart forcibly to ensure complete irrigation of eyes & lid tissues.

c) Never attempts to neutralize chlorine with chemicals.

## CHAPTER 40: SAFETY IN HANDLING OF REINFORCEMENT

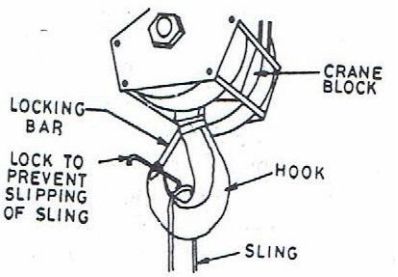
Handling of reinforcement includes loading, unloading, storing, straightening, cutting, bending, binding etc. The following safety measures shall be considered during handling of reinforcement:

1. Appropriate cutting tool and other tool shall be used.
2. Handling of reinforcement area shall be guarded.
3. Projected edge of the reinforcement shall be covered.
4. Loose clothing shall not be allowed.
5. Rubber pad shall be used by the worker on shaller while carrying on shaller.
6. Leather hand gloves, safety shoes and helmet shall be used by the worker while handling of reinforcement.
7. Plain goggles shall be used for eye protection against flying object during cutting operation.
8. Reinforcement shall be hold firmly during all operations to avoid fall on the body.
9. Nearing persons shall be alerted during bending and carrying operation to avoid hitting.
10. Safe work practice shall be maintained regarding working on height and scaffolding.

## CHAPTER 41: SAFETY IN USE OF LIFTING MACHINES & TACKLES

**LIFTING MACHINE**: It Means crane, crab, winch, pulley block, gin wheel, stacker, forklift, hydra, transporter or runway etc. (used for lifting and shifting loads). It is also called as lifting appliance in BOCW Act 1996 and Dock Workers (Safety, Health and Welfare) Act, 1986 (54 of 1986).

**LIFTING TACKLE:** It means any chain sling, rope sling, hook, shackle, swivel, coupling, socket, clamp, lifting beam, tray / similar appliance, whether fixed / movable, used in connection with the raising / lowering / shifting of loads by use of lifting machines / appliances. It is also called as LIFTING GEAR or loose gears in BOCW Act 1996 & Dock Workers Act 1986. The lifting tackles normally used are Wire Rope Sling, chain sling, Shackles, Eye Bolt, Swivel, Hook, clamps, Turn buckles etc.




1. No lifting machines, chains, ropes, lifting tackles not to be overloaded (except for testing) beyond Safe Working Load (SWL). The S.W.L. to be plainly marked with identification mark, test date, due date of inspection. A register with all such entries be maintained.
2. All lifting machines shall be inspected atleast once in 12 months by competent person (authorized by DISH / CIF). It is the responsibility of head of concern department to get it tested by the competent person.
3. All lifting appliances, including their parts and working gear, whether fixed or movable and any plant or gear used in anchoring or fixing of such appliances shall be of sound construction, sound material and of adequate strength to serve the purpose for which these are to be used and all such appliances shall be free from patent defects, and maintained in good repair and working condition.
4. Every drum or pulley around which the rope of any lifting appliance is carried shall be of adequate diameter and sound construction in relation to such rope.
5. Any rope that terminates at the winding drum of a lifting appliance shall be securely attached to such drum and at least three dead turns of such rope remain on such drum in every operating position of such lifting appliance.
6. The flange of a drum projects twice the rope diameter beyond the last layer of such rope and if such projection is not available, other measures like anti-slackness guards shall be provided to prevent such rope from coming off such drum.
7. Every lifting appliance shall be provided with adequate and efficient brakes which shall be capable of preventing fall of suspended load (including any test load) and of effectively controlling such load while it is being lowered, act without shock and shall have shoes that can be easily removed for running and shall be provided with simple and easily accessible means of adjustment. Provided that nothing contained above shall apply to steam-winch that can be operated as safely as with brakes.
8. Controls of every lifting appliance shall be so situated that the driver of such appliance at his stand or seat has ample room for operating and has an unrestricted view of work, as far as practicable, and that he remains clear of the load and ropes, and that no load passes over him and are positioned with due regard to ergonometric considerations for proper operation of such appliance and shall be so located that the driver of such appliance remains above the height of the heel block during the whole

operation of such appliance and shall have upon them or adjacent to them clear markings to indicate their purpose and mode of operations and shall provide, where necessary, with a suitable locking device to prevent accidental movement or displacement and shall move, as far as practicable, in the direction of the resultant load movement and wherever automatic brakes are provided, they shall automatically come to the neutral position in case of power failure.

9. All lifting appliances including all parts and gears thereof, whether fixed or movable, shall be tested and examined by a competent person before being taken into use for the first time or after it has undergone any alteration or repairs liable to affect its strength or stability or after erection on a site and also once at least in every five years, in the manner as specified.
10. All lifting appliances shall be thoroughly examined by a competent person at least in every twelve months and where the competent person making such examination forms the opinion that the lifting appliance cannot continue to function safely, he shall forthwith give notice in writing of his opinion to the owner of the lifting appliance.
11. If safe working load may be varied by raising or lowering of the jib or otherwise of a crane, an automatic indicator of safe working load shall be attached which gives a warning to the operator wherever the load exceeds the safe working load.
12. Cut-out shall be provided which automatically arrests the movement of the lifting parts of every crane if the load exceeds the safe working load, wherever possible.
13. Where if it is not possible to install an automatic safe load indicator, in that case, provision of a table showing the safe working loads at the corresponding inclinations or radii of the jib on the crane shall be considered sufficient.
14. Fixed lifting appliances shall be installed by a competent person in a manner that such appliances cannot be displaced by the load, vibration or other influences, the operator of such appliance is not exposed to danger from loads, ropes or drums and the operator can either see over the zone of operation or communicate with all loading and unloading points by signal, or other communication system.
15. Adequate clearance shall be provided between parts or loads of lifting appliances and the fixed objects such as walls and posts, or electrical conductors.
16. The lifting appliances, when exposed to wind, loading are given sufficient additional strength, stability and rigidity to withstand such loading safely.
17. No structural alterations or repairs shall be made on any part of the lifting appliances that affect the safety of such appliances without obtaining the opinion of the competent person to this effect.
18. Winches shall not be used if their control levers operate with excessive friction or play.
19. Double gear winches shall not be used unless a positive means of locking the gearshift is provided.
20. There shall be no load other than the fall and the hook assembly on the winch while changing gears on a two gear winch.
21. Adequate protection shall be provided to the winch operator against abnormal weather.
22. Temporary seats or shelters for winch operators which may pose hazard to the winch operator or any other workers shall not be allowed to be used.
23. Control levers shall be secured in the neutral position and, whenever possible, the power shall be shut-off whenever the winches are left unattended.
24. Electric winches shall not be used for building work where the electro-magnetic brake is unable to hold the load, or one or more control points, either hoisting or lowering, are not operating properly.
25. The tip-up buckets are equipped with a device that effectively prevents accidental tipping.
26. Every lifting appliance and loose gear shall be clearly marked for its safe working load and identification by stamping or other suitable means.
27. Every derrick (other than derrick crane) shall be clearly marked for its safe working load when such derrick is used either in single purchase with lower block or in union purchases in all possible block positions.
28. The lowest angle to the horizontal, to which the derrick may be used, shall be legibly marked.

29. Every lifting appliance having more than one working load shall be fitted with effective means to enable the operator to determine safe working load at each point under all conditions of use.
30. Means to ascertain the safe working load for lifting gears under such conditions in which such gears may be used shall be provided to enable a worker using such gears and such means shall consist of:
    (i) marking the safe working load in plain figures or letters upon the sling or upon a tablet or ring of durable material attached securely thereto in case of chain slings, and
    (ii) the means specified above or notices so exhibited as can be easily read by any concerned worker stating the safe working load for the various sizes of the wire rope slings used.
31. No lifting appliance, lifting gear or wire rope shall be used in an unsafe way and in such a manner as to involve risk to life of workers and they are not loaded beyond their safe working load except for testing purposes under the direction of a competent person.
32. No lifting appliance and lifting gear, or any other material-handling appliance shall be used if the Inspector having jurisdiction is not satisfied with reference to a certificate of test or examination or to an authenticated record maintained or if in his view the lifting appliance, lifting gear or any other material handling appliance is not safe for use in work.
33. No pulley block shall be used unless the safe working load and its identification are clearly marked on such block.
34. Operator of every lifting machine in outdoor service shall be provided with a cab or cabin which shall
    (i) be made of fire resistant material;
    (ii) has a suitable seat, a foot rest and protection from vibration;
    (iii) affords the operator an adequate view of the area of operation**;**
    (iv) affords the necessary access to working parts in the cab;
    (v) affords the operator adequate protection against the weather;
    (vi) be adequately ventilated; and
    (vii) be provided with a suitable fire extinguisher.
35. Operator of every crane or lifting appliance shall possess adequate skill and training in the operation of the particular lifting appliances.
36. No person under eighteen years of age shall be in control of any lifting machine, scaffold winch, or give signals to the operator.
37. Precaution shall be taken by the trained operator to prevent lifting appliance from being set in motion inadvertently.
38. The operation of lifting appliances shall be governed by signals in conformity with the relevant national standards.
39. The operator's attention shall not be distracted while he is working.
40. No crane, hoist, winch or other lifting appliance or any part of such crane, hoist, winch or other lifting appliance shall, except for testing purposes, be loaded beyond the safe working load.
41. During the hoisting operations, effective precaution shall be taken to prevent any person from standing or passing under the load in such operation.
42. Operator shall not leave lifting appliance unattended while power is on or the load is suspended to such appliance.
43. No person shall ride on a suspended load or on any lifting appliance.
44. Every part of a load in course of being hoisted or lowered shall be adequately suspended and supported to prevent danger.
45. Every receptacle used for hoisting bricks, tiles, slates or other material shall be suitably enclosed as to prevent the fall of any such material.
46. The hoisting platform shall be enclosed when loose materials or loaded wheel barrows are placed directly on such platform during lifting or on lowering such materials or wheel barrows.
47. No material shall be raised, lowered or slewed with any lifting appliance in such a way as to cause sudden jerks to such appliance.
48. In hoisting a barrow, any wheel of such barrow shall not be used as a means of support unless adequate steps have been taken to prevent the axle of such wheel from slipping out of its bearing.

49. Long objects like planks or girders shall be provided with a tag line to prevent any possibility of danger while raising or lowering such objects.
50. During the process of landing or material, a worker shall not be permitted to lean out into empty space for finding out the loading and unloading of such material.
51. When hoisting of load is done at places where there is regular flow of traffic is carried out in an enclosed space, or in case such hoisting is impracticable in enclosed space, measures shall be taken to hold up or divert the traffic during the time of such hoisting.
52. Adequate steps shall be taken to prevent a load, in the course of being hoisted or lowered from coming into contact with any object to avoid any displacement of such load.
53. Appropriate appliances shall be provided and used for guiding heavy loads when raising or lowering heavy loads to avoid crushing of hands of workers during such raising or lowering of loads.
54. Hoist towers shall be designed according to the relevant national standards.
55. Hoist shafts shall be provided with rigid panels or other adequate fencing at the ground level on all sides of such shafts and at all other levels on all sides of the access to such shafts.
56. The walls of hoist shafts, except at approaches, extend at least two meters above the floor or platform of access to such shifts.
57. Approaches to a hoist shall be adequately lit and provided with gates that shall be guarded to maintain visibility at least of two meters height and equipped with a device, which requires such gate to be closed before the platform of such hoist can leave the landing and prevents the gate from being opened unless such platform is at the landing.
58. The guides of hoist platforms shall offer sufficient resistance to bending and to bucking in the case of jamming, by providing a safety catch.
59. Overhead beams and their supports shall be capable of holding the total maximum live and dead loads so that such beams and supports will be required to carry, with a safety factor of at least five.
60. A clear space shall be provided above the highest stopping place of a cage or platform to allow sufficient unobstructed travel of such cage or platform in case of over winding and below the lowest stopping place of such cage or platform.
61. Adequate covering shall be provided above the top of hoist shafts to prevent materials from falling into such shafts.
62. Outdoor hoist towers shall be erected on adequately firm foundations and securely braced, guyed and anchored.
63. A ladder way shall extend from the bottom to the top of every outdoor hoist tower in case no other ladder way exists within easy reach and such ladder way shall comply with the relevant national standards.
64. The rated capacity of a hoisting engine shall at least be 1.5 times the maximum load that such engine will be required to move.
65. All gearing on a hoisting engine shall be securely enclosed.
66. Steam piping of hoisting engine shall be adequately protected against accidental contact of such piping with a worker.
67. Electrical equipment of a hoisting engine shall be effectively earthed.
68. A hoist shall be provided with suitable devices to stop a hoisting engine as soon as the platform of such hoist reaches its highest stopping place.
69. A hoisting engine shall be protected by suitable cover against weather and falling objects.
70. A hoisting engine set up in a public thoroughfare shall be completely enclosed.
71. All exhaust steam pipes shall discharge steam in such a manner that the steam so discharged does not scald any person or obstruct the operator's view.
72. The motion of a hoist shall not be reversed without first bringing it to rest to avoid any harm from such reverse motion.
73. A hoist not designed for the conveyance of persons shall not be set in motion from the platform of such hoist.
74. Pawls and ratchet wheels of a hoist requiring disengagement of such pawls from such ratchet wheels,

before the platform of such hoist is lowered, shall not be used.

75. A platform of a hoist shall be capable of supporting such maximum load that such platform may carry with a safety factor of at least three.
76. A platform of a hoist shall be equipped with suitable safety gear which can hold such platform with its maximum load in case its hoisting rope breaks.
77. On platform of a hoist, the wheel barrows or truck shall be efficiently blocked in safe positions.
78. A cage of a hoist or a platform where the workers are required to enter into such cage or to go on such platform at landing level shall be provided with a locking arrangement to prevent such cage or platform from moving during the time a worker enters or leaves such cage or platform.
79. The sides of a platform of a hoist which are not used for loading or unloading, shall be provided with toe-board and enclosures of a wire mesh or any other suitable means to prevent the fall of any part of a load from such platform.
80. The platform of a hoist, which has any probability of falling and any part of a load from it, shall be provided with an adequate covering with such fall.
81. The counter weights of a hoist consisting of an assemblage of several parts shall be so constructed that such parts shall be rigidly connected together.
82. The counter weights of a hoist shall run between guides.
83. At every level of work the workers shall be provided with adequate platforms for performing such work.
84. A legible notice in Hindi as well as in a local language shall be displayed at a conspicuous place of the platform:
    (i) of a hoist and that such notice shall states the maximum carrying capacity of such hoist in kilograms;
    (ii) on the hoisting engine and that such notice shall states the maximum lifting capacity of such hoist in kilograms;
    (iii) on a hoist authorized and certified for the conveyance of the persons on the platform or in the cage and such notice shall states the maximum number of persons to be carried on such hoist at one time;
    (iv) on a hoist carrying goods and other materials and such notice shall state that such hoist is not meant for carriage of persons.
85. Safe means of access shall be provided to every part of lifting appliances.
86. The operator's platform on every crane or tip driven by mechanical power shall be securely fenced and provided with safe means of access and where access to such platform is by a ladder,
    (i) the sides of such ladder shall extend to a reasonable height beyond such platform or some other suitable handhold shall be provided in the platform to prevent any falling of persons;
    (ii) the handling place on such platform shall be maintained free from obstruction and slipping;
    (iii) in case the height of such ladder exceeds six meters, the resting platforms shall be provided on such ladder at every six meters of its height and where the distance between last platform so provided and the top end of such ladder is more than two meters then on such top end.
87. Every derrick shall have current and relevant rigging plans and any other information necessary for the safe rigging of such derrick and its gear.
88. Appropriate measures shall be taken to prevent the foot of a derrick being lifted out of its socket or supports.
89. Every lifting gear shall be:
    (i) of good design and construction, sound material and adequate strength to perform the work for which it is used;
    (ii) free from patent defects; and
    (iii) properly maintained in good repair and working order.
90. Components of the loose gear, at the time of its use, shall be renewed if one of its dimensions at any point has decreased by ten per cent or more.

91. A chain shall be withdrawn from use when it is stretched and increased in length which exceeds five per cent of its length or when a link of such chain is deformed or is otherwise damaged or raised scarves of defective welds have appeared on it.
92. Rings, hooks, swivels and end links attached to a chain shall be of the same materials as that of such chain.
93. The voltage of electric supply to any magnetic lifting device shall not fluctuate by more than plus or minus10%.
94. A lifting gear shall be initially tested for the manufacturer by a competent person before taking into use or after undergoing any substantive alterations which renders it's any part liable to affect its safety and such gear alters such test shall subsequently be retested for the use of its owner at least once in every five years.
95. A lifting gear in use shall be thoroughly examined once at least in every twelve months by a competent person.
96. A chain in use shall be thoroughly examined once at least every month by a responsible person for its use.
97. Certificates of initial and periodical tests and examinations of loose gears shall be obtained from the competent person.
98. No rope shall be used for work unless :
    (i) it is of good quality and free from patent defects; and
    (ii) in the case of wire rope, it shall be tested and examined by a competent person.
99. Every wire rope of lifting appliance or lifting gear used for work shall be inspected by a responsible person for such use, once at least in every there month. However, if any such wire is broken in such rope, the responsible person shall thereafter inspect it once at least in every month.
100. No wire rope shall be used for work if in any length of eight diameters of such wires, the total number of visible broken wires exceed ten per cent of the total number of wires in such rope, or such rope shows sign of excessive wear, corrosion or other defects which in the opinion of the person who inspects it, is unfit for use.
101. Eye splices and loops of ropes for the attachment of hooks, rings and other such parts to wire rope shall be made with suitable thimble.
102. A thimble or loop splice made in any wire rope sling shall conform to the following standards, namely-
    (i) wire rope sling shall have at least three tucks with full strand of rope and two tucks with one-half of the wires cut out of each of such strand in all cased, such strands shall be tucked against the lay of the rope;
    (ii) protruding ends of such strands in any splice of wire rope slings shall be covered or treated so as to leave no sharp points;
    (iii) a fiber rope or a rope sling shall have at least four tucks, tail of such tuck being whipped in a suitable manner; and
    (iv) a synthetic fiber rope or rope sling shall have at least four tucks with full strands followed by further tuck with one-half filaments cut out of each of such strand and final tuck with one-half of the remaining filaments cut out from such strands. Any portion of the splices containing such tucks, with reduced number of filaments, shall be securely covered with suitable tape or other materials. Provided that nothing contained in the above shall apply where any other form of splice which may be as efficient as the splice with above standards, is used.
103. All chains other than bridle chains attached to derricks and all rings, hooks, shackles and swivels used in hoisting or lowering of such derricks shall be effectively annealed under supervision of a competent person and at the following intervals, namely:
    (i) such chains, rings, hoods, shackles and swivels which are not more than twelve and a half millimeter of length annealed at least once in every six months; and
    (ii) all other such chains rings hooks shackles and swivels shall be so annealed at least once in every twelve months; Provided that, the above clause shall not apply to –
    a. pitched chins, working on sprocket or sprocket wheels;

b. rings, hooks and swivels permanently attached to pitched chains, pulley blocks or weighing machines, and
c. hooks and swivels having ball bearings or other case hardened parts.

104. A chain or a loose gear made of high tensile steel or alloy steel shall be plainly marked with a mark indicating that it is so made.
105. No chain or loose gear made of high tensile steel or alloy steel shall be subjected to any form of heat treatment except where such treatment is necessary for the purpose of repair of such chain or loose gear and that such repair shall be made under the direction of the competent person.
106. The wrought iron gear, the past history of which is not traceable, shall be suspected of being heat treated at incorrect temperature shall be normalized before using it on any work.
107. A competent person shall issue a certificate after actual testing or examination of the apparatus specified above.
108. A register shall be maintained and particulars of such test and examination of lifting appliances, lifting gears and heat treatment as required shall be entered in such register.
109. Certificate in respect of each of the following shall be obtained from a competent person:
    (i) in cases of initial and periodical test and examination of the lifting appliances such as Winches, Derricks and their accessory gears, Cranes or Hoists and their accessory gears;
    (ii) in case of test, examination and re-examination of loose gears;
    (iii) in case of test and examination of wire ropes;
    (iv) in case of heat treatment and examination of loose gears;
    (v) in case of annual thorough examination of the loose gears, except where required particulars of such exemption have been enclosed in the register referred to and such certificates are attached to the register and kept at site in case such register and certificate relate to lifting appliances, loose gear and wire ropes and shall produce on demand and retained for at least five years after the date of the last entry made in such register.
110. No lifting appliance or lifting gear in respect of which an entry is required to be made in the register referred to above and certificate of test and examination are required to be attached in such register shall be used for work unless the required entries have been made in such register and certificates.
111. No vacuum lifting gear, magnetic lifting gear or any other lifting gear where the load on it is held by adhesive power, shall be used while workers are performing operations beneath such gear.
112. A magnetic lifting gear used in connection with work shall be provided with an alternative supply of power, such as batteries, which may come into operation immediately in the event of failure of the main power supply.
113. No worker shall work within the swinging zone of the lifting gear or load or other material suspended to such lifting gear.
114. No chain or wire rope with a knot in it shall be used in work.
115. No worker shall be raised, lowered or carried by a power driven lifting appliance, except
    (i) on the drive's platform in the cage of a crane; or
    (ii) on a hoist; or
    (iii) on an suspended scaffold;

    Provided that, a worker may be raised, lowered or carried by a power driven lifting appliance:
    a. in circumstances where the use of a hoist or of a suspended scaffold shall not reasonably be practicable, or
    b. on an aerial cableway or aerial ropeway, provided further that the following requirements are met:
    i) that the appliance referred to above can be operated from one position only, and
    ii) that any winch used in connection with the appliance shall also comply with the requirements as laid down above.
    iii) that the appliance referred to above shall not carry any person except in a chair or cage, or in a skip or other receptacle at least three feet deep which shall be suitable for safe carriage of a person and any such chair, cage, skip or other receptacle shall be made of good construction,

sound material, and adequate strength and properly maintained with suitable means to prevent any occupant therein from falling out of it and shall be free from any material or tools which may interfere with the handhold or foothold of such occupant or otherwise endanger him; and

iv) that suitable measures shall be taken to prevent the chair, cage skip or other receptacle from spinning or tipping in a manner dangerous to any occupant therein.

116. No worker shall be carried with the help of a hoist unless it is provided with a cage which:
    (i) is so constructed as to prevent, when its gates are shut, any worker carried by such hoist from falling out of it or from being trapped between any part of such cage and any fixed structure or other moving part of such hoist or from being struck by articles or materials falling down the hoist way on which such hoist is moving; and
    (ii) is fitted on each of its side from which access is provided to a landing place with a gate which has efficient interlocking or other devices to secure so that such gate cannot be opened except when such cage is at a landing place and that such cage cannot be moved away from any such place until such gate is closed.
117. Every gate in the hoist way enclosure of such hoist used for carrying persons shall be fitted with efficient interlocking or other devices to secure so that such gate cannot be opened except when the cage of such gate is at the landing place and that such cage cannot be moved away from the landing place until such gate is closed.
118. In every hoist used for carrying workers shall be provided with suitable and efficient automatic devices to ensure that the cage of such hoist comes to rest at a point above the lowest point to which such cage may travel.
119. When a sling is used to hoist long materials, a lifting beam shall be used to space the sling legs for proper balance and when a load is suspended at two or more points with slings, the eyes of the lifting legs of such slings shall be shackled together and such shackle or eyes of the shackled slings shall be placed on the hook or the eyes of such lifting legs shall be shackled directly to the hoisting block, ball or balance beam, as the case may be.
120. Every container or receptacle used for raising or lowering stone, bricks, tiles, slates or other similar objects shall be so enclosed with the hoist as to prevent the fall of such objects.
121. Loaded wheel barrows placed directly on a platform of a hoist for raising or lowering of such wheel barrows shall be so secured that such wheel barrows cannot move and such platform shall be enclosed to prevent the fall of the contents kept in such wheel barrows.
122. Landings of hoists shall be so designed and arranged that workers on such hoist be not required to lean out into empty space for loading and unloading on any material from such hoist.
123. No person other than the operator trained and capable to work at heights shall be employed to operate tower cranes.
124. The ground on which a tower crane stands shall have adequate bearing capacity.
125. Bases for tower cranes and trucks for rail mounted tower cranes shall be firm and leveled and such cranes erected at a reasonably safe distance from excavations and operated within gradient limits as specified by the manufacturer of such cranes.
126. Tower cranes shall be sited where there is a clear space available for erection, operation and dismantling of such cranes.
127. Tower cranes shall be sited in such a way that the loads on such cranes shall not be handled over any occupied premises, public thoroughfares, and railways or near power cables, other than work sites for which such cranes are used.
128. Where two or more tower cranes are sited and operated, every care shall be taken to ensure positive and proper communication between operators of such cranes to avoid any dagger or dangerous occurrences.
129. Tower cranes shall not be used for loading magnet or demolition ball service, piling operation or other similar operations which could impose excessive load stresses on the crane structure of such cranes.
130. The instructions of the manufacturer of a tower crane and standard safe practices regarding such cranes shall be followed while operating or using such cranes.

131. No person shall be employed to drive or operate a lifting appliance whether driven by mechanical power or otherwise or to give signals to driver or operator of such lifting appliance or to work as an operator of a rigger or derricks unless he is
    (i) sufficiently competent and reliable;
    (ii) possesses the knowledge of the inherent risks involved in the operation of lifting appliance;
    (iii) medically examined periodically as specified by the relevant rule and
    (iv) is above eighteen years of age.
132. When mobile crane is moved, it shall be ensured that the jibs do not come in contact with overhead power cables or structure or line.
133. In case of power failure, move the switch to "off" position.
134. Tag or lock the main switch before making any repairs.
135. Cranes shall be examined for loose or defective gears, keys, runways, railing, warning bells, switches, sweep brushes every day. Make sure the crane is kept clean and well lubricated.
136. Never allow the crane to drag chain slings, hooks or load along the floor or ground.
137. Make familiar with the location of the main isolating switch and all emergency crane switches.
138. Ensure that all times the work load never exceeds the maximum load that can be safely lifted by the crane at the given radius and jib or derrick position. Be especially careful of this when the jib is lowered while handling a load.
139. Every hoist and lift shall be:
    (i) of good mechanical construction, sound material and adequate strength.
    (ii) properly maintain, and shall be thoroughly examined by a competent person at least once in every period of six months, and a register shall be kept containing the prescribed particulars of every such examination.
140. Every hoist way and lift way shall be sufficiently protected by an enclosure fitted with gates, and the hoist or lift and every such enclosure shall be so constructed as to prevent any person or thing from being trapped between any part of the hoist or lift and any fixed structure or moving part.
141. The maximum safe working load be plainly marked on every hoist or lift and no load greater than such load shall be carried thereon.
142. The cage of every hoist or lift used for carrying persons shall be fitted with a gate on each side from which access is afforded to a landing.
143. Every gate shall be fitted with interlocking or other efficient device to secure that the lift / hoist cannot be moved unless the gate is closed.
144. The record of examination of hoist and lift and of lifting machine, ropes and lifting tackles by competent person shall be maintained in Form scheduled as per Factories Act, 1948 and once in a period of 12 months and due record kept in scheduled Form, respectively.
145. When new chain is obtained it shall be measured for its length. For the slings, the overall length from bearing point to bearing point shall be measured accurately. When the length of any chain is increased by more than 5% of its original length, the chain shall be discarded. When measuring the length, allowance shall be considered for wear at the bearing point, which would naturally increase the length of the chain due to wear.
146. Each link of the chain shall be inspected particularly at the point of bearing. If any link which has changed shape or showing cracks in welded areas shall be removed and tested with proof load after removal.
147. The following important points shall be observed:
    (i) Chain made from iron of less than 5/6" diameter shall not be used for lifting purpose.
    (ii) It shall not be loaded beyond its safe working capacity.
    (iii) While using chain slings over sharp corners, padding of gunny bags, wooden blocks, shall be used.
    (iv) It shall never be dragged from under a load.
    (v) Unauthorized repairs of defective parts such as hammering the chain to straight a link or force

the link into position shall not be done. Repairing shall be done either by the manufacturer or the authorized person.

(vi) Excessively pitted, corroded, worn-out, bent or twisted links or those having a tendency of weld to open, shall not be used.

(vii) Chain shall not be spliced by inserting a bolt between two links.

(viii) Chain attachments such as rings, hooks, shackles, swivels, couplings and end link shall be made of the same metal and shall be of same safe working load as chains.

(ix) It shall be the responsibility of the concerned plant engineer to ensure that all defective chains and chain slings are withdrawn and are discarded.

(x) When not in use, it shall be stored in such a place as to avoid rusting and damaged from any source.

(xi) Chains shall be slowly and evenly taken up and it shall be ensured that the link seat properly as the chain takes the load when the chain links forms a link. No load shall be applied before a link is removed.

(xii) Increase in angle between two legs of chain sling reduces its lifting capacity. For a two legged sling, the angle between the legs shall not exceed 90 degree.

(xiii) Rings, shackles, couplings and end link shall not be interchanged from one chain to another.

(xiv) The hook of the chain shall be so adjusted that the load properly sits in the blow of the hook and not on tip.

(xv) Ensure that chain pulley blocks are inspected at least once in twelve (12) months by competent persons and due record kept.

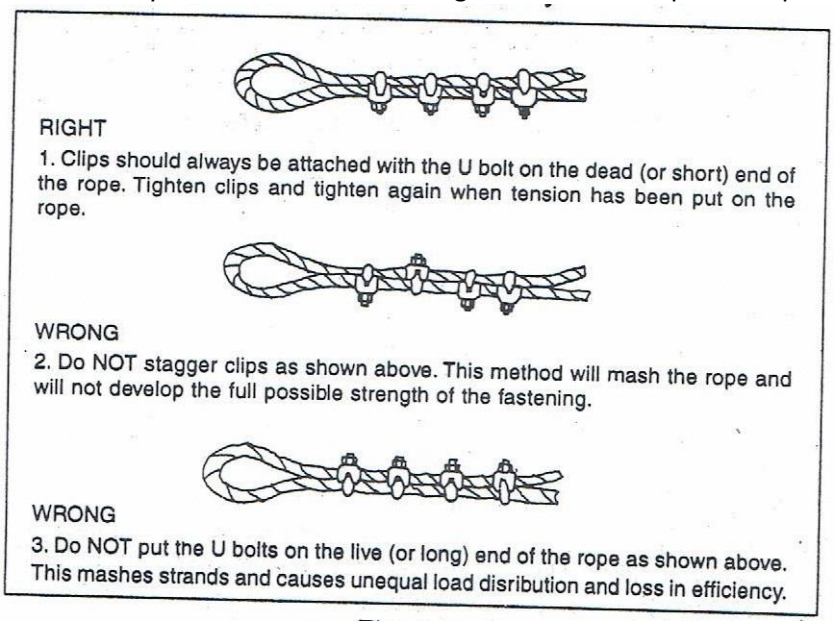
(xvi) Chain pulley blocks shall be hanged on a solid structure capable of withstanding the load.

(xvii) No employee shall stand beneath of pulley block when the block is loaded.

(xviii) Safe working load shall be marked on each chain pulley blocks by a metal tag or other means.

148. Rope shall not use, if it is possible to use suitable steel wire slings.
149. If however, they are to be used, the following precaution shall be taken Ropes are generally made of natural fibres such as Manila sisal hemp for synthetic fibres (Nylon, polyester and poly propylene). Application of different type of ropes must be done after studying the properties of various ropes.
150. New rope shall be inspected along its entire length thoroughly. Used ropes shall not be used unless its history is known.
151. Ropes in service shall be inspected every 30 days, under ordinary conditions and much often if used in critical conditions.
152. Inspection shall consists of an examination of entire length of the rope, inch by inch for wear abrasions, powdered fibres between strands, broken or cut fibre, displacement of yarns or strands.
153. To inspect the inner fibre, the ropes shall be untwisted in several places to examine the inner yarns.
154. Precautions shall be taken to keep rope in good condition. Avoid kinking as it is likely to over stress the rope.
155. Twisted rope shall be handled so as to retain the amount of twist that the rope seeks when free and relaxed. Improper coiling and uncoiling change the twist it can be restored by proper twisting canes of either end. Several twists can cause damage to rope.
156. Avoid sharp bends. If the object have sharp corners, pads shall be used.
157. When length of rope must be joined, they shall be spliced & not knotted.
158. Use of wet rope or of rope with metallic strands, near power lines equipment is extremely dangerous.
159. Ropes shall be stored in dry place always keep away from moisture, sunlight, chemicals and heat and always cleaned before storing.
160. The wire rope is composed of wires, strands and core. Normally wire ropes in use are of 6x19 or 6x37 classification i.e. ropes having stands consisting of 19 or 37 wires. The greater the number of wires in the rope, the more flexible is the rope. Only standard wire rope shall be used.
161. Eye splices, sockets and rope anchorage shall be capable of withstanding a load to be lifted and shall be capable of withstanding a load 95% of the rated breaking load of the wire rope. It shall be provided with a suitable thimble.

162. Size, material and maximum safe working load shall be marked on all wire rope slings.
163. End of wire rope shall be seized to prevent the strands from being loose.
164. Fastening of wire ropes and rope slings shall be regularly examined and whenever their strength is affected by broken wires, corrosion or kinks shall be rejected. If 10% or more broken wires are found the wire rope shall be discarded.
165. Wire rope shall be lubricated at regular intervals and stored in a cool place away from heat and moisture.
166. Wire ropes or wire rope slings shall not be dragged against the ground or against sharp or rough objects.
167. While using wire ropes or slings, avoid sharp angles or bend and if so put padding.
168. Where double or multiple slings are used for hoisting purpose, the upper end of slings shall be connected by means of shackles or ring and shall not be placed separately in the lifting hook.




169. All defective wire ropes, rope slings that show evidence of cuts, abrasion, excessive wear, fatigue or other defects shall be discarded and destroyed.
170. Hooks and rings used with chain shall be of material as good as that of the chain. Forged steel is preferable for lifting heavy loads.
171. A ring must be strong enough to carry a load equal to the sum of safe loads of all attached chains.
172. Hooks bent by overloading shall be discarded.
173. Hooks that close and lock shall be used. Maximum safe working load shall be stamped on each hook.
174. Grooves of sheeves used in connection with chain shall be provided with pockets to fit the link to chain.
175. Grooves of sheeves shall have round edges, a smooth surface and rope shall run free without chaffing against the block or other suspended parts.
176. Sheeves that have become worn, chipped or corroded shall be discarded.
177. Bottom blocks for hoisting shall be protected with close fitting guards and ring handles so as to prevent hands of workers from being caught in the sheeves or between the sheeves and load.

## CHAPTER 42: FREQUENCY & TYPE OF TESTS FOR LIFTING AND OTHER EQUIPMENTS

**A. Examination of Hoists and Lifts**: Under Section 28 of The Factories Act, 1948

1. Every hoist and lift shall be:
   (i) of good mechanical construction, sound material and adequate strength.
   (ii) properly maintain, and shall be thoroughly examined by a competent person at least once in every period of six months, and a register shall be kept containing the prescribed particulars of every such examination.

**B. Examination of Lifting Machines and Lifting Tackles**: Under Section 29 of The Factories Act, 1948

1. All lifting appliances including all parts and gears thereof, whether fixed or movable 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.
2. 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 to function safely, he shall forthwith give notice in writing of his opinion to the owner of the lifting appliance.
3. A register containing the details of all lifting equipment mentioning their capacity, year of make, specifications, their identification number, testing date, last date of examination and the next due date of examination must be maintained.

**C. Examination of Pressure Vessels**: under sub section (2) of section 31 of Factory Act, 1948,

1. It is mandatory that the identification number, safe working pressure, test pressure, last testing date and the next due testing date are painted / written on the pressure vessel.
2. All pressure vessels need to be externally examined once in six months, internally examined once in a year and hydro tested for safe working pressure once in a period of four years. If internal examination is not possible then the hydraulic pressure testing shall be done once in a period of two years.
3. The working of the safety valve is to be checked at regular frequency and records be maintained in the log books. The records of these testing and examination are to be maintained for future reference.

## CHAPTER 43: HANDLING, TRANSPORTATION AND USE OF EXPLOSIVES

**A. General:**

1. The authority shall keep an accurate up to date record of explosive, blasting agent, blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored at operation site.
2. The use of explosives shall be carried out in a safe manner to avoid injury to any person and under the direct supervision of a responsible person.
3. No person other than authorized and competent one shall be allowed to handle and use explosives.
4. Before using any explosive, necessary warning and danger signals shall be erected, at conspicuous places of such use to warn the workers and the general public of the danger involved in such use.
5. Naked lamps, smoking and other source of ignition shall be prohibited in or near explosives magazines or while explosives are being handled, transported or used.
6. No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors or dangerous drugs.
7. The explosives shall be accounted for at all times. No explosives or blasting agents shall be abandoned.
8. No fire shall be fought where the fire is in the imminent danger of contact with explosives. All employees shall be removes to a safe area and the fire area shall be guarded against intruders.
9. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity or otherwise.
10. Short-circuiting of detonators in holes, which have been primed and shunted until wired into the blasting circuit.
11. The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.
12. The prominent display of adequate signs, warning against the use of radio-transmitters, on all roads within 1000 ft of blasting operations. Whenever adherence to the 1000 ft distance would create an operational handicap, a competent and expert person shall be consulted to evaluate the particular situation, and an alternative provided, which are adequately designed to prevent any premature firing of electric blasting of caps. A description of any such blasting shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for inspection.
13. Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.
14. Explosives, blasting agents and blasting supplies that are obviously deteriorated or damaged shall not be used.
15. Delivery and issue of explosives shall only be made authorized persons into authorized magazines or approved temporary storage or handling areas.
16. Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken. In such situations controlled blasting shall be restored to.
17. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.
18. Loaded boreholes shall not be left unattended after the end of the shift.
19. Suitable and sufficient means of egress to ground level shall be provided in all cases of excavations, trenches, all other places where explosives are handled above or below ground level.
20. At an appropriate time before the final blasting warnings, workers in the area shall be removed to a designated safe place.

21. An unmistakable, audible, final warning shall be sounded one minute prior to the detonation of explosives; after completion, when the person in charge has established that safe conditions prevail, an "all clear" shall be sounded. To prevent persons entering any danger zone during blasting operations notices shall be given to all concerned. Notices shall indicate:
    (i) that explosives are in use;
    (ii) the audible warning sound and the "all clear" and state when they will be sounded; and
    (iii) the warning flags in use, including an "all clear" flag.
22. Precautions against lightning shall be provided in accordance with the Indian Electricity Act and Indian Explosives Act and Rules and regulations framed there under.
23. Package containing explosives shall not be dragged, dropped or handled roughly.
24. Non-sparking tools shall be used to open keys.
25. The explosives shall not be carried in the box or otherwise on any individual.
26. Nothing shall be inserted in the open end of the blasting cap except fuses.
27. Deteriorated or damages explosives shall not be used but shall be disposed or destroyed strictly in accordance with the approved methods and in the doing so the manufacturers or the appropriate authority's instructions shall be followed.
28. Lighting shall be in accordance with Indian Electricity Act/Rules.
29. No person shall handle or cause to be handled any explosive between the hours of sunset and sunrise : Provided that nothing in this rule shall apply to handling of explosives during the dark hours if proper illumination is provided in the area and the place is guarded.

**B. Transportation of explosives:**

1. Keep safe distance and to use non-sparking tools while opening packages containing explosives.
2. Stop the use of explosives and handling thereof while the weather conditions are not suitable for such use or handling.
3. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power-lines, dust storms or other sources of extraneous electricity or otherwise. These precautions shall include –
    (i) Suspension of all blasting operations and evacuation of persons;
    (ii) All warning signs shall be displayed within 200 m of blasting operations and in case putting up a sign at 200 m is impractical, the contractor shall consult the Engineer-in-charge for alternatives;
    (iii) All loading and firing shall be directed and supervised by competent persons thoroughly experienced in the field;
    (iv) To prevent persons entering any danger zone during blasting operations, notices shall be given to all concerned.
4. In addition to these provisions, all measures and precautions that are required to be observed for use, handling, storing or transportation of explosives under the Rules framed under the Explosives Act, 1884 (4 of 1884) shall be observed.
5. All the relevant statutory provisions, local laws and rules and regulations shall be complied with.
6. Where the magazine is located near the construction site and blasting operation continues daily, actual requirement of explosives shall be drawn from the magazine and transported to the site. Any leftovers shall be returned to the magazine each time after the blast. In case of work at scattered places and for a small duration, portable magazines shall be used and kept within a fence in safe place and properly guarded.
7. For carrying higher quantity (more than 5 kg of explosives) specially designed insulated containers shall be used. These containers shall be constructed of finished wood not less than 5cm thick or plastic not less than 6mm thick or pressed fibre not less than 10mm thick. There shall be no metal parts (not even nails, bolts, screws etc.) and the containers shall be provided with suitable nonconductive carrying device, such as rubber, leather or canvas handle or strap.

8. Vehicles to be used for transportation explosives shall be in good working condition and shall have a tight wooded or non-sparking metal (copper, brass and the like) floor with sides and ends high enough to prevent the explosives from failing off the vehicle. In open bodied vehicles, the explosives shall be covered with a waterproof and fibre tarpaulin.
9. Electrical wiring in vehicle shall be fully insulated so as to prevent the danger of short-circuiting and at least two fire extinguishers of carbon dioxide type shall be carried. The vehicle shall be properly marked indicating adequate warning to the public in regard to the nature of cargo.
10. No metals except approved metal truck shall be allowed to come in contact with cases of explosives, metal, flammable, or corrosive substance shall not be transported with explosives. As far as possible, transportation of any material along with explosives shall be prohibited.
11. Smoking shall be prohibited in the vehicle carrying explosives.
12. No unauthorized person shall be allowed in the vehicle, carrying explosives.
13. Loading and unloading of explosives shall be done carefully.
14. Explosives and detonators or blasting caps shall not be permitted to be transported in the same vehicle.
15. Detonators and other explosives for blasting shall be transported to the site of work in the original containers or in securely locked separate non-metallic containers and shall not be carried loose or mixed with other materials.

**C. Storage of explosives and blasting agents:**

1. Explosives and related materials shall be stored in approved facilities.
2. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents.
3. Smoking and open flames shall not be permitted within 50 feet of explosives and detonators storage magazine.
4. No Explosives or blasting agents shall be permanently stored in any underground area until the area has been developed to the point where at least two modes of exit have been provided.
5. Permanent underground storage magazine shall be at least 300 feet from any shaft or other active underground working area.
6. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.
7. No person shall smoke, and no fires, lights or articles or substances of a flammable nature or liable to spontaneous ignition, or act to cause or communicate fire or explosion such as acids, petroleum, carbide of calcium, compressed gases or such other hazardous substances, or radio or cell phone or radio frequency operated device or any such communication system or devices shall be allowed at any time within fifteen metres from the place where an explosive is stored or at any place where an explosive is handled during transport one hour before and during such handling.
8. Marking on explosives and packages shall be as per Explosive Rules 2008.
9. Electrically Non-conductive shoes (having no metallic nails etc.) shall be used while handling and using explosives.

**D. Drilling and loading:**

1. Before planning out the drilling operations for blasting purposes, nature of stratum and the over burden shall necessarily be examined to avoid possibilities of landslides after blasting.
2. The face or rock shall be carefully examined before drilling to determine the presence of unfired explosives**.** No attempt shall be made to drill at a site if undetonated explosives are suspected. In such case the boreholes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed, but cylindrical throughout) shall be used in the charging the holes. The cartridge will be on the top.

3. The borehole shall be carefully checked for length, presence of water dust, etc. with a wooden temping pole or a measuring tape before loading.
4. Surplus explosives shall not be stacked near working areas during loading or unloading. Loading and Drilling shall not be carried out at the same time in the same area.
5. The line of detonating fuse extending into a borehole shall be cut from the spool before loading the remainder of the charge.
6. A bore shall not be loaded with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making sure it is cool and it does not contain any hot smoldering material. Temperatures in excess of 65 degree centigrade are dangerous.
7. A bore near another hole loaded with explosives shall not be sprung.
8. No force shall be used for inserting cartridges or any explosives into a bore hold or pass any obstruction in a borehole.
9. No force shall be used for inserting a blasting cap or an electric blasting cap into explosive. The cap shall be inserted into a hole made with a pickers designed for the purpose. A hitch of the electric blasting cap leading wire shall be made on the primer cartridge so as to prevent pulling out the electric blasting cap from the explosive charge. In case of fuse, the fuse shall be tied to the explosive cartridge so that the blasting cap is not pulled out. Care shall be taken so that the blasting cap is not pulled out. Care shall be taken so that the electric blasting cap, leading wire or the length of the fuse does not get damaged during loading of the charge.
10. To attempt shall be made to slit, drop, deform or abuse the primer.
11. Blasting caps or electric blasting caps shall not be connected to detonating fuse except by methods recommended by the manufacturers of caps.
12. Explosive cartridge shall not be cut, nor explosive removed from the cartridge for use.
13. Metallic devices of any kind shall not be used in tamping. Wooden tamping tools with not exposed metal parts except non-sparking metal connectors for jointed poled shall be used. Violent tamping shall be avoided. Primer shall not be tamped.
14. Care shall be taken to confine the explosives in the bore hold with sand, earth clay or other suitable combustible stemming material.
15. Kinking or injuring of fuse or electric blasting cap wires shall be avoided when tamping.
16. All holes loaded on a shift shall be fired during the same shift.

**E. Electrical shot-firing circuit:**

1. In deciding the sizes of wires, fuses, circuits, blasting switches, etc., instructions issued by the manufacturers of these articles shall be followed, if they do not contradict with Indian Explosives Act or framed under it.
2. No person shall attempt to uncoil the wires and open out the short-circuited bare leading wires of the electric blasting cap during approach of dust storm or near any source of large charge of static electricity or near a radio transmitter. The manufacturer of the cap or the Inspectorate of Explosives shall be consulted regarding the distance from the transmitter beyond which electric short firing shall be conducted.
3. Firing circuit shall be kept completely insulated from the ground of the other conductors, such as wires, rails, pipes or other paths or stray current.
4. There shall not be any electric live wires or cables of any kind near electric blasting caps or other explosives except at the time and for the purpose of firing the blast.
5. All electric blasting caps shall be tested singly and also when connected in a circuit in series using only an approved type of circuit continuity tester or ohmmeter.
6. No attempt shall be made to use in the same circuit either electrical blasting caps made by more than one manufacturer or electric blasting caps of different design or function even if made by the same manufacturers unless such use is approved by the manufacturers.

7. No attempt shall be made to fire a circuit of electric blasting caps with less than the minimum current specified by the manufacturer of that electric blasting cap.
8. No current from a signaling, lighting or power circuit shall be used for firing shot. The leading wires of detonator shall be kept short-circuited until ready to fire.
9. Copper wires with solid core of appropriate gauge shall be used for firing lines; the wires shall be adequately insulted and in sound condition.
10. Blasting operations in the proximity of overhead power lines, communication lines, utility line or other structures shall not be carried out until the operator or the owner, both of such lines has been notified and the precautionary measures deemed necessary, have been taken.
11. Each electric detonator shall be tested with an approved galvanometer before and after tamping in a hole to determine whether it will carry the current. The number of electric detonators used in a circuit shall not exceed the tested capacity of the Exploder (Blasting Machine).
12. Care shall be taken to ensure that all wire ends to be connected are bright and clean.
13. The electric cap wires or leading wires shall be kept short circuited until ready to fire.
14. The energy for blasting is taken from power circuits the voltage shall not exceed 220v.
15. The wiring controlling arrangements shall conform to the following:
    (i) The blasting switch shall be strictly according to the specifications, externally operated double-throw switch, which when locked in the open position will short circuit and ground the leading wires. The switch shall be installed at the location where the firing is to be controlled.
    (ii) A 'safety' switch of the same type as the blasting switch shall be installed between the blasting switch and the firing circuit and lead lines, at a distance not to exceed 180cm from the blasting switch.
    (iii) Both the safety switch and the blasting switch shall be locked in the open position immediately after the shot and before any person is permitted to return to the blasting area. Key to the switches shall remain in the possession of the blaster at all times.
    (iv) Rubber covered or other adequately insulated copper wires in good condition shall be used for firing lines and shall have solid cores of appropriate gauge. Sufficient firing line shall be provided to permit the blaster to be located at a safe distance from the blast. Single conductor lead lines shall be used.
16. Blasting operations in the proximity of overhead power lines, communication lines, utility lines, or other structures shall not be carried on until the operator or the owner, or both of such lines as been notified and precautionary measures deemed necessary, have been taken.
17. All holes loaded on a shift shall be fired on the same shift.
18. As far as possible, blasting shall be carried out using suitable exploder with 25 per cent excess capacity. Electric power from the mains shall be used only when it is absolutely necessary.

**F. Shot-firing with safety fuse:**

1. Blasting operation shall be carried out by a shot firer holding valid certificate issued by the Controller of explosive.
2. A copy of the certificate shall be carried by the shot fired during blasting operations.
3. The shot firer shall take all due precautions in handling or charging or blasting operations.
4. Not more than 12 holes shall be loaded and shot at one time if detonation is done with safety fuse.
5. The fuse shall be carefully handled to avoid damaging the covering. In very cold weather the fuse shall be slightly warmed before using so as to avoid cracking the waterproofing.
6. Short fuse shall not be used. The length of a fuse shall not be less than 120cm. The rate of burning of the fuse shall be known and it would be necessary to make sure that it will take sufficient time in burning so as to enable all persons to reach a place of safety. The burning rate of the fuse shall not be more than 60 cm/min.
7. The fuse shall not be cut until the operation to insert the fuse into a blasting cap is ready. The fuse shall be cut off about 2.5 to 5 cm to ensure a dry end. It shall be cut squarely across with a clean and sharp

blade. The fuse shall be seated lightly against the cap charge and care shall be taken to avoid twisting after it has been placed in position.

8. Blasting caps shall not be crimped by any means except by a cap crimper designed for the purpose. It shall be necessary to make sure that the cap is squarely crimped to the face.
9. The fuse shall be lighted with a fuse lighter designed for the purpose. If a match is used, the fuse shall be slit at the end and the match head held in then slit against the power core and then the match head rubbed against an abrasive surface to light the fuse.
10. The fuse shall not be lighted until sufficient stemming has been placed over the explosives to prevent sparks of live match heads from coming into contact with the explosives.
11. The explosives shall not be held in hands when lighting the fuse.

**G. Underground work:**

1. Only permissible explosives and in the manner as specified by the appropriate authority shall be used.
2. Excessive quantities of explosives shall not be taken underground at any time. Black blasting powder or pellet powder shall not be used with any other explosive in the same borehole.

**H. Before and after firing:**

1. Before firing, sufficient warning shall be given to enable the people working in the area to get off the danger zone. The danger zone shall be suitable cordoned off and flag men posted at important points.
2. No drilling shall be started until the previous holes in blasted area are flushed with water.
3. While planning drilling operations for blasting purposes, consideration must be given to the nature of stratum and the overburden with a view to avoiding the possibilities of landslides after blasting.
4. The face of rock shall be carefully examined before drilling, to determine the possible presence of unfired explosive. No attempt shall be made to drill at a site if undetonated (misfire) explosives are suspected.
5. The position of all holes to be drilled shall be marked out with white paint.
6. The borehole shall be cleared of water, dust, etc. before explosive is inserted.
7. The diameter of the borehole shall be greater than the outer diameter of the explosive cartridge.
8. Loading and Drilling shall not be carried out at the same time in the same area.
9. A borehole shall not be loaded without making it sure that it is cool and that it does not contain any hot metal, burning or smouldering materials. Temperatures in excess of 65 degree centigrade are dangerous.
10. A borehole near another hole loaded with explosives shall not be sprung.
11. A tool made of wood suitable for charging and stemming shot holes
12. Scraper made of brass or wood, suitable for cleaning out short holes;
13. Where fuses are used, a knife for cutting off fuses and unless machine capped fuses are provided also a pair of suitable crimpers for crimping detonators
14. Where detonators are used, a picker made of wood or a non-ferrous metal, for priming cartridges.No attempt shall be made to slit, drop, deform or abuse the primer.
15. No hole shall be loaded except those to be fired on the next round of blasting.
16. Metallic devices of any kind shall not be used in tamping the explosive cartridges. Wooden Tamping tools can only be used.
17. Drilling shall not be resumed after the blasts have been fired until a thorough examination has been made to make sure that there are no unexploded charges in the remaining old holes.
18. Rock Drillers shall be equipped with approved respirators for use in the silica-dust atmosphere in addition to other Safety gears like, Safety Helmet, Goggles, Safety Shoes, Earplug, etc.
19. No loose materials, such as tools, drilling implements etc. shall be left on the rock surfaces to be blasted.
20. Blasting in the open shall be carried out during the fixed hours every day or on fixed days in the week.

This information shall be amply publicized and the following precautions observed:

(i) On the project sites, where blasting operations are carried out, daily blasting hours shall be clearly printed on the sign-boards on all the roads approaching that area.
(ii) Road closing barriers shall be provided to close the traffic on these roads, at least 400 meters away when the firing is to take place.
(iii) The beginning of the firing shall follow loud sirens and similarly loud sirens shall succeed the completion of the firing.

21. The shot-firer shall not be allowed to return to the blasting site after firing, until at least 5 min have elapsed. In case of electric shot firing, the shot holes shall be examined after firing and in case of misfire.
22. No person shall be allowed to approach the blasting site for at least 5 min. In case of shot firing with safety fuse, utmost care shall be taken to count the number to ensure that all the shots have fired and in the event of misfire, no person shall be allowed to approach the blasting site for at least 30 min. In any case, a careful inspection for the remaining un-detonated explosive shall be made after firing the shots. All misfired shot holes shall be cross-marked. No person other than those duly authorized shall approach the holes until one of the following operations has been performed in respect of each of the misfired holes.
    (i) If the misfire is due to a faulty cable or faulty electrical connection the defect shall be remedied and the shot fired.
    (ii) The stemming shall be floated out by use of water or air jet from hose until the hole has been opened to within 60 cm of the charge, whereupon water will be siphoned or pumped out, then a fresh new charge placed and duly detonated. Or
    (iii) A careful search shall be made of unexploded material in the debris of the charge.
    (iv) If a shift charge is unavoidable, the person in-charge of one shift before leaving the work shall inform the person relieving him for the next shift of any cases misfired and shall point out their position duly cross marked and also state clearly what action has to be taken in the matter.
23. No explosive shall be abandoned. These shall be disposed off or destroyed strictly in accordance with the approved methods and in doing so the manufacturers or the appropriate authority shall be consulted.
24. Explosives, detonators, boxes lines or material used in packing explosives shall not be left lying around in places to which children or unauthorized persons or livestock can access. Paper or fibrous material used in packing explosives shall not be put to any subsequent use. Such materials shall be destroyed by burning in the presence of a responsible person.
25. Account Inventory Register-An Inventory Register containing the details, Explosives received, placed in, removed from and returned to storage Magazines shall be maintained current at all times.
26. Explosive Issue Register- A careful day to day account of the explosives shall be maintained in an approved register and manner, which shall be open to inspection at all times. Explosives shall be issued only by competent person upon written requisition signed by the blaster or by an official authorized for the purpose and only against the signature or thumb impression. Such requisitions shall be preserved by the person-in-charge of the magazine.
27. Blasting Register: A register shall be maintained to record the following details each blast:
    (i) Date & Time of blast
    (ii) Number of holes
    (iii) Type of explosive used
    (iv) Amount of charge per hole
    (v) Firing Pattern & Sequence

**I. Blasting Checklist:**

1. Are warning boards provided at least 400m away from blasting area, at all the approaches?
2. Are only authorized and qualified persons permitted to handle explosives?

3. Are smoking, firearms, matches, open flame lamps and other fires, flame or heat producing devices and sparks prohibited in or near explosive magazines and while explosives are being handled, transported, or used ?
4. Is use of cell-phones/Walkie-talkies prohibited in or near explosive magazines and while explosives are being handled, transported, or used?
5. Are registers maintained for inventory and use of explosives?
6. Are explosives not in use kept in a locked magazine?
7. Are precautions taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lighting, adjacent power lines, dust storms, and other sources of extraneous electricity?
8. Does the Blaster possess license?
9. Do the Blasting Personnel use safety shoes of electrically non-conductive material?
10. Is every vehicle or conveyance used for transporting explosives marked on both sides, front and rear with placards reading “EXPLOSIVES” in red letters not less than four inches high on white background ?
11. Are blasting caps and Primers transported in different vehicles?
12. Are blasting caps, electric blasting caps, detonating primers, and primed cartridges stored in separate magazines?
13. Is tamping done only with wooden rods or plastic tamping poles without exposed metal parts except for non-sparking metal connections of jointed poles ?
14. Is a loud warning signal given by the blaster in-charge before the blast is fired?

## CHAPTER 44: SAFETY IN TRANSPORTATION, EARTHMOVING EQUIPMENT AND OTHER CONSTRUCTION EQUIPMENT/MACHINERY

**A. Earthmoving equipment and vehicles:**

1. All vehicles and earthmoving equipment shall be made of good material, proper design and sound constructional and be sufficiently strong for the purpose for which such equipment are properly used in accordance with standard safe operating practices.
2. Provided that the truck or trailer employed for transporting freight containers shall be of the size sufficient to carry the containers, without over hanging and provided with twist locks conforming to approved standards, at all the four corners of each of such use by an authority under the relevant law for the time being in force and is inspected by a responsible person, at least once in a month and record of such inspection shall be maintained.
3. All transport or earth moving equipment and vehicles shall be inspected at least once a week by a responsible person and in case any defend is noticed in such equipment or vehicle it shall be immediately taken out of use.
4. Power trucks and tractors shall be equipped with effective brakes, headlights and tail lamps and maintained in good repair and working order.
5. Side stanchions on power trucks and trailers for crying heavy and long objects shall be
   (i) of sound construction and free from defects;
   (ii) provided with tie chains attached to the top across the loads for preventing such stanchions from spreading out; and
   (iii) kept in position while loading and unloading;
   (iv) safe gangways provided for to and fro movement of building workers engaged in loading and unloading of lorries, trucks, trailers and wagons;
   (v) trucks and other equipment shall not be loaded beyond their safe capacity and carry workers engaged in loading and unloading of lorries, trucks trailers and wagons in an unsafe condition;
   (vi) handles of trucks shall be so designed as to protect the hands of the building workers working on such trucks, or such handles provided with knuckle guards;
   (vii) no unauthorized person shall ride the transport equipment employed in such work;
   (viii) a driver of a transport equipment shall maneuver such equipment under the direction of a signaler;
   (ix) adequate precaution such as isolating the electric supply or erecting overhead barriers of a safe height shall be taken when earth moving equipment or vehicles are required to operate in dangerous proximity to any live electric conductor;
   (x) vehicles and earth moving equipment shall not be left on a slope with the engine of such vehicles or equipment running;
   (xi) all earth moving equipment, vehicles or other transport equipment shall be operated only by such person who are adequately trained and possess such skills as required for safe operation of such equipment, vehicle or other transport equipment.

**B. Power shovels and excavator:**

1. A shovel or an excavator whether operated by steam or electric or by internal combustion, shall be constructed, installed, operated, tested and examined as per approved standards.
2. Excavator equipped for use as a mobile crane shall be examined and tested in accordance with the requirements for such mobile cranes as laid down by the manufacturer.
3. Fitted with an automatic safe working load indicator.
4. Buckets or grabs of power shovels shall be propped to restrict the movement of such buckets or grabs while being repaired or while the teeth of such buckets or grabs are being changed.

**C. Bulldozer:**

1. Operator of every such bulldozer before leaving the dozer shall take the following steps:
   (i) Lower the blade and sipper;
   (ii) Put the shift lever into neutral;
   (iii) Dozer left on level ground at the close of the work for which such bulldozer is used;
   (iv) The blade of a bulldozer kept low when such bulldozer is moving uphill;
   (v) The bulldozer blades not used as brakes except in an emergency.

**D. Scrapers:**

1. A tractor and scraper shall be joined by safety line at the time of its operation.
2. The scraper bowls shall be propped while blades of such scraper are being replaced.
3. A scraper moving downhill shall not be left in gear.

**E. Mobile asphalt layers & finishers:**

1. A mixture elevator shall be located within a wooden or sheet metal enclosure with a window for observation, lubrication and maintenance.
2. Bitumen scoops shall have adequate covers.
3. When asphalt plants are working on public road, adequate traffic control shall be established on such road and the building workers working with such plant provided with reflective jackets.
4. A sufficient number of fire extinguishers shall be kept in readiness at such workplace where fire hazards may exist.
5. The materials shall be loaded on the elevator after the drying drain has warmed up of such elevator.
6. No open light shall be used for ascertaining the level of asphalt.
7. Inspection opening shall not be opened till there is a pressure in the boiler, which may cause injury to building workers.

**F. Pavers:**

1. Pavers shall be equipped with guards suitable to prevent building workers from walking under the skip of such pavers.

**G. Road rollers:**

1. Before a road roller is used on the ground, such ground shall be examined for its bearing capacity and general safety, especially at the edges of slopes such as embankment on such grounds and shall not be moved downhill with the engine out of gear.

**H. General safety in respect of powered construction machinery:**

1. Every vehicle or earthmoving equipment shall be equipped with and fully functional with the following:
   (i) Silencers
   (ii) Tail lights
   (iii) Power and hand brakes
   (iv) Reversing alarm
   (v) Search light for forward and backward movement, which are required for safe operation of such vehicle or earthmoving equipment.
2. The cab of vehicle or earthmoving equipment shall be kept at least one meter from the adjacent face of a ground being excavated.
3. When cranes of shovel are traveling, the boom of such crane or shovel shall be in the direction of such

travel and the bucket or scoop attached to such crane or shovel raised and without load except when such traveling is downhill.

4. Driver's Cabin:
   (i) Motor trucks, tractors and dumpers shall be equipped with a cabin or a canopy of sufficient strength and so installed as to provide adequate protection to the driver.
   (ii) If the cabin is enclosed, it shall be provided with windows giving maximum possible view and shall be well ventilated. The driver shall be able to make a easy exit in case of any emergency.
   (iii) Driver's seat shall have backrest and the seat shall be of such design, construction and dimensions as will absorb vibration sufficiently and provide reasonable comfort.
   (iv) Motor trucks and tractor's shall be equipped with a footboard steps and hand-holds such that it is possible to get into and out of the driver's cabin safely and the cabin shall be so arranged that the driver can easily get off in case of emergency.
5. Brakes and Controls: Motor trucks, tractors and dumpers shall be equipped with brakes that will hold them under the heaviest load that may be hauled in any operating conditions and shall enable the vehicle to be locked when stationary.
6. Draw Gears: Motor trucks, hauling trailers and tractors shall be equipped with draw gear such that during coupling no workmen can come between the vehicles being coupled or the vehicles being coupled cannot run into each other.
7. Vehicles shall not move down the hill with the engine off or with the engine out of gear.
8. Drivers shall be required to leave the cabins and stand in the clear while the motor trucks are being loaded.
9. Drivers of tripper trucks used for hot mix plants and batch mix concrete plants and similar operations shall wear the industrial safety helmets.
10. Other operating Conditions
   (i) Motor trucks shall be stationed at such a distance from the power shovel (excavator) that there is a clearance of at least 0.6m between the trucks and the superstructure of the power shovel (excavator) even when it pivots.
   (ii) Where the driver does not have a clear field of vision the movement of motor trucks and tractors shall be controlled by a code of standard hand signals.
   (iii) When uncoupling vehicles, both vehicles shall be blocked by brakes or chocks.
   (iv) Vehicles being loaded or unloaded shall be effectively braked or blocked.
   (v) Motor trucks shall not be loaded beyond their capacity.
   (vi) Before a loaded motor truck starts, the load shall be inspected to ensure that it is secure, evenly distributed and of safe height, length and width.
   (vii) Sufficient stop blocks shall be provided at every tipping point and these shall be used on every occasion when material is dumped from the truck damper.

## CHAPTER 45: SAFETY IN WELDING AND GAS CUTTING OPERATIONS

### A. Oxyacetylene Gas welding and cutting:

### a) General:

1. All welders shall be provided with fire & heat resistant protective clothing and equipment, such as fire resistant gauntlets and leather aprons, helmets and goggles with suitable filter lenses.
2. The welders shall wear clothing that is free from grease, oil and other flammable material.
3. Precautions shall be taken to protect persons working or passing near welding operations from dangerous sparks and radiation.
4. Workers shall be protected from toxic or harmful fumes either by exhaust ventilation or respiratory protective equipment.
5. The oxygen pressure for welding shall always be high enough to prevent acetylene gas flowing back into the oxygen cylinder.
6. Adequate precautions shall be taken to prevent:
   (i) fire being started by sparks;
   (ii) slag or hot metal; and
   (iii) damage to fibre ropes and hose from heat, sparks, slag or hot metal.
7. Precautions shall be taken to prevent flammable vapours and substances from entering the working area.
8. The welder shall ensure that there is no leakage in regulator, hose pipe, torch and cylinders before starting of the work.
9. Flame flash back arrestor shall be used in regulator.
10. While opening the valve of cylinder, care shall be taken to operate or turn slowly to avoid bursting of regulator.
11. For lighting the torch, valve of oxygen gas cylinder shall be open first and then acetylene gas cylinder.
12. Carry out Welding and Gas Cutting in well-ventilated and well-illuminated places only.
13. Ensure that the area is free from flammable substances.
14. Ensure that welding sparks/cutting hot iron pieces do not fall through floor opening / floor grating on chemicals / equipment / cable etc.
15. If a leak in the valve cannot be rectified by tightening the gland nut or the spindle, remove the cylinder to an open space where it is least dangerous to life.
16. Cylinders used in horizontal position shall be so secured that they cannot roll.
17. Use Personal Protective Equipment like Goggles / Glass shield, Gloves, Shoes, and Masks etc. as required.
18. Cylinders together with their valves and other fittings and the identification colours under these rules shall always be maintained in good condition.
19. No cylinder shall be subjected to any heat treatment or exposed to a high temperature or to the Sun or stored with any other flammable or explosive material.
20. Every cylinder containing compressed gas shall have its valve securely closed so as to prevent leakage. Valves fitted to the cylinders containing Liquefied Petroleum Gas and highly toxic gases shall be provided with security nut on the outlet to act as a secondary means of safeguard against leakage of gas.

### b) Welding at places with fire risks:

1. Unless adequate precautions are taken, no welding or cutting operations shall be allowed near the place where combustible materials are stored.

2. Combustible materials and structures that cannot be removed from the vicinity of welding operations shall be shielded by asbestos or protected by other suitable means.

**c) Welding in confined space:**

1. Adequate ventilation, by means of exhaust fans shall be constantly provided; otherwise enough quantity of air shall be flown in by means of compressors to dilute the pollutants.
2. No blow pipe shall be left unattended inside a tank or vessel or other confined space during interruption of the work.
3. An attendant shall watch the welders from outside.

**d) Welding on containers for explosive or flammable substances:**

1. Welding or cutting operations on containers in which they are explosives or flammable substances shall not be allowed.
2. Welding or cutting operations on any container that has held explosive or where flammable gases may have been generated, shall only be undertaken after the container has been thoroughly cleansed by steam or other effective means and found by air tests to be completely free from combustible gases and vapours or after the combustible gas in the container has been completely replaced by an inert gas or by water.
3. If an inert gas is used, after the vessel has been filled with gas, the gas shall continue to flow slowly into it thorough out the welding or cutting operations.

**e) Cutting operations:**

The following sequence of operation shall be followed for carrying out a safer cutting operation:

1. Open the acetylene cylinder with the help of the cylinder key to half a turn.
2. Adjust the regulator screw on the Acetylene regulator to the required pressure and then do the same for the oxygen line, in both the cases the Cutogen valves on the torch are closed.
3. Now open the Acetylene cutover valve, purge the hose and close it. Then do the similar exercise for the oxygen.
4. Close the oxygen line valve on the torch and ignite the torch.
5. Adjust the oxygen to the required pressure.
6. While closing, close the oxygen cylinder and regulator then the Acetylene cylinder and regulator.
7. Close the oxygen torch valve then the Acetylene valve.

**f) Backfire & Flash Back:**

1. Backfire occurs when the flame burns back into the blowpipe often with a sharp bang. This may happen when the blowpipe is held too close to the work-piece, or if the nozzle is blocked or partly blocked. The flame may go out or it may re-ignite at the nozzle. Sometimes the flame burns back into the blowpipe, and burning continues at the mixing point. Backfires do not usually cause serious injury or damage but they indicate a fault in the equipment.
2. Flashbacks are commonly caused by a reverse flow of oxygen into the fuel gas hose (or fuel into the oxygen hose), producing an explosive mixture in the hose. The flame can then burn back through the blowpipe, into the hose and may even reach the pressure regulator and the cylinder. The consequences of a flashback are potentially very serious. They can result in damage or destruction of equipment, and could even cause the cylinder to explode. This could end in serious injury to personnel and severe damage to property.
3. If a backfire does occur:

(i) The blowpipe valves shall be shut off, oxygen first and then the fuel gas;
(ii) Oxygen and fuel gas cylinder valves shall be shut off;
(iii) The blowpipe shall be cooled with water, if necessary;
(iv) The equipment shall be checked for damage or faults, particularly the nozzle.
(v) Cylinder valves of both fuel gas and oxygen shall be closed immediately, if it is safe to do so. The flame shall go out when the fuel gas is shut off. If the fire cannot be put out at once, the area shall be evacuated and emergency fire services shall be called;
(vi) The blowpipe, hoses, regulators, flashback arresters and other components may have been damaged. The damaged ones shall be replaced before reuse.

4. The following precautions will help to prevent flashbacks:
   (i) The hoses shall be purged before lighting the blowpipe to remove any potentially explosive gas mixtures. Spark igniter shall be used to ignite the gas quickly after turning it on;
   (ii) Flashback arresters shall be provided at both ends of the hoses to prevent backflow of gas towards cylinders;
   (iii) Correct gas pressure and for the nozzle size shall be used.
5. If an acetylene cylinder catches fire or gets heated due to severe back fire or external heat source, it shall be dealt with promptly as follows :
   (i) The valve shall be shut.
   (ii) Try to extinguish the fire.
   (iii) Regulator or other fittings shall be detached.
   (iv) It shall be immersed in water or water shall be applied copiously at the bottom half of the cylinder.
   (v) The valve shall be opened for few minutes and the cylinder, kept cool in water until it becomes empty.
   (vi) No one shall stand in the direction of the fusible safety valve fixed at the bottom of the cylinder.

**g) Hose:**

1. Hose especially designed for welding and cutting operations shall be used to connect an oxy-acetylene torch to gas outlet.
2. Hose lines for oxygen and acetylene shall be of different colours and preferably of different size.
3. Hose connections shall be sufficiently light to withstand without leakage a pressure twice the maximum delivery pressure of the pressure regulators in the system.
4. Care shall be taken that hose does not become kinked or tangled, stepped on or run-over or otherwise damaged.
5. No hose with more than one gas passage shall be used.
6. Only soapy water shall be used for testing hose for leaks.
7. Proper clamp shall be used in hose connection.
8. Grease or oil shall not be used on oxygen line connection.
9. Copper fitting shall not be used in acetylene line.
10. Hoses shall be kept away from the working area to prevent contact with flames, heat, sparks or hat spatter.

**h) Torches:**

1. Torches shall be lit with friction lighters but not with matches.
2. Tip of the torch shall be free from dirt & metal.

**B. Electric arc welding:**

**a) General:**

1. For individual welding machines, the rated current-carrying capacity of the supply conductors shall be not less than the maximum primary current of the welding machines. All the moving and rotating parts of the welding equipment shall be guarded. In case of Engine-run welding machines, refueling shall not be done while the machine is running and spilling of oil shall be avoided.
2. Welding machines shall be controlled by a switch mounted on or near the machine framework that, when opened, immediately cuts off the power from all conductors supplying the machine.
3. Welding circuit shall be so designed as to prevent the transmission of high potential from the source of supply to the welding electrodes.
4. The maximum open circuit voltage shall be in accordance with Indian Standards.
5. Electrode conductors or cables shall not be excessive in length and shall not be longer than necessary to perform the work.
6. Return conductors shall be taken directly to work and securely connected mechanically and electrically to it or to the work bench, floor etc. and to an adjacent metallic object.
7. Cable shall be supported so as not to create dangerous obstruction.
8. Only heavy-duty cable with unbroken insulation shall be used.
9. Circuit connections shall be waterproof.
10. When lengths of cable have to be joined, only insulated connectors shall be used on the earth line and the electrode holder line.
11. All welding cables shall be of completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress. When it becomes necessary to connect or splice the cables, substantial insulated connectors of a capacity at least equivalent to that of the cable, shall be used. If connections are effected by means of cable lugs, then these lugs shall be securely fastened together by means of bolts to give good electrical contact. The exposed metal parts of the lugs shall be completely insulated. The work lead (welding lead) shall be attached firmly to the work. Work lead shall be as short as possible.
12. When, in the course of work, a welding cable becomes worn out, exposing bare conductors, the portion thus exposed shall be adequately insulated with heat resistance tape.
13. Welding cables shall be kept dry where practicable and free from grease and oil to prevent premature breakdown of the insulation.
14. When it becomes necessary to carry cables some distance from machines, they shall be substantially supported overhead, if practicable. If this is not possible, and cables are laid on the floor or ground, they shall be protected in such a manner that they would not be damaged, entangled or interfere with safe movement of people. Special care shall be taken to see that welding supply cables are not in proximity to power supply cables or other high-tension wires.
15. Laying of cables shall be so as not to created tripping hazard in the work place.
16. Motors, generators, rectifiers and transformers in arc welding or cutting machines, and all current carrying parts, shall be protected against accidental contact with uninsulated live parts.
17. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot.
18. Frames of arc welding machines shall be effectively earthed.
19. In hand-operated arc welding machines, cables and cable connectors used in arc welding circuits shall be effectively insulated on the supply side.
20. The outer surface electrode holders of hand-operated arc welding machines, including the jaw so far as practicable, shall be effectively insulated.
21. Electrode holders of hand-operated arc-welding machines shall, if practicable, be provided with discs or shields to protect the operator's hands from the heat of the arcs.
22. Any current-carrying parts passing through the portion of the holder, which the welder grips in his hand shall be fully insulated against the maximum voltage encountered to ground. Insulation of all, metallic or current carrying parts, including the jaws, which grip the electrodes, is recommended wherever service conditions permit. The cable shall be free from repair or splices up to a minimum

distance of 3.0 m from the electrode holder. Electrode holders shall be provided with discs or shields to protect the hands of the operator from the heat of the arcs.

23. Welding current shall be returned to the welding machine by a single, cable from the work to the welding machine. Connection of a cable from the welding machine to a common conductor or structure on which the work rests, or to which the work is connected may be permitted. Pipelines containing gases or flammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit. Wire rope, reinforcement rods, etc. shall not be used to carry welding current. All earth connections shall be checked to determine that they are mechanically strong and electrically adequate for the required current.
24. Electrode shall be removed from holders when not in use to eliminate danger of electrical contact with persons or conducting objects. Electrode holders when not in use shall be so placed that possibilities of electrical contact between them and persons or conducting objects are eliminated.
25. Connections to welding terminals shall be made at distribution boxes, socket outlets, etc. by bolted joints.
26. Welding terminals shall be adequately protected against accidental contact by enclosures, covers or other effective means.
27. Electrode holder shall have adequate current capacity and be adequately insulated to prevent shock, short-circuiting or flashovers.

**b) Operations:**

1. Arc welding and cutting operations that are carried on at places where persons other than the welders are working or passing shall be enclosed by means of suitable stationary or mobile screens.
2. Walls and screens of both permanent and temporary protective enclosures shall be provided to absorb harmful rays from the welding equipment and prevent reflection, and if necessary, be painted or otherwise treated for the purpose.
3. When arc welding is done in damp confined spaces, electrode holders shall be completely insulated and the welding machines shall be outside the confined space.
4. Welders shall take adequate precautions to prevent any part of their body from completing an electric circuit, to prevent contact between any part of the body and the exposed part of the electrode, or electrode when in contact with metal and to prevent wet or damaged clothing, gloves and boots from touching any live part.
5. Welding circuits shall be switched off when not in use.
6. Electrodes shall only be inserted in the holder with insulating means such as insulating gloves.
7. Live parts of electrode holders shall be inaccessible when they are not in use.
8. Electric arc-welding equipment shall not be left unattended with current switched on.
9. A scrap bin shall be provided and used near welding work to deposit electrode stubs.
10. Burn electrode shall not be less than 38 to 50 milimetre in length. Electrode holder may damage if electrode burns less than 38 to 50 milimetre.
11. Welding equipment used in the open shall be protected from inclement (rainy) weather conditions. Protective coverings shall not obstruct the ventilation necessary to prevent overheating of the machine. When not in use, the equipment shall be stored in a clean dry place. Machines, which have become wet, shall be thoroughly dried before being used.
12. It is good practice to blow out the entire generator type-welding machine occasionally with clean, dry compressed air.
13. Welding in wet, damp or humid conditions reduces the skin resistance of the body and insulating properties of accessories. Hence no welding shall be done unless suitable protection is provided.
14. If there is a risk of heavy rain, a cover for the welder, equipment and work piece shall be in place.

**c) Fire Prevention and Protection:**

1. No person shall smoke and no fires, other than blow pipe flames for repairs, or no articles or such other substances of flammable nature or liable to spontaneous ignition or to cause or communicate fire or explosion shall be allowed at any time in proximity to a place where any cylinder for flammable gases is being filled, stored or handled.
2. No person in or near any place where cylinders containing flammable gases are filled, stored or handled shall have in his possession any matches, fuses, mobile phones or any other appliances for producing ignition or explosion.
3. No person shall commit or attempt to commit any act, which may tend to cause a fire or explosion in or about any place where gas under pressure in a cylinder is stored, handled or transported.
4. Either the work-piece shall be moved to a safe location for carrying gas-cutting work or combustible materials and flammable materials shall be removed from the work place.
5. Spaces where welding fumes could accumulate shall be ventilated.
6. If combustible materials that cannot be moved shall be protected from close contact with flame, heat, sparks or hot slag. Suitable guards or covers such as metal sheeting, mineral fibre boards or fire retardant blankets shall be used; in such case hot work permit shall be obtained.
7. Guards or covers shall be used to prevent cylinders from hot particles passing through openings in floors and walls.
8. Fire extinguishers, fire buckets with water shall be kept nearby.

## CHAPTER 46: SAFETY OF STRUCTURES AND BUILDING

1. No wall, chimney or other structure or part of a structure shall be left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration.
2. Structural frame work & formwork, scaffolding etc. shall be safe & stable so as to ensure safety of the employees working on such sites.
3. Material used for construction, design, soil conditions, wind direction and weather are responsible for the overall safety of the structure. Due to design fault or change in earth crust where the structure is standing is responsible for the collapse of the structure.
4. Due to ageing post construction maintenance has to be carried out. This has to be done by regularly conducting structural audits from competent persons from time to time.
5. Material and equipment used for construction shall conform to the Indian standards.
6. Necessary fire safety measures shall be provided at construction site.
7. Following care shall be taken while excavation is carried out near a structure or building:
   (i) Where there is any doubt as to the stability of any structure/building adjoining the workplace or other areas to be excavated or where tunneling work is to be carried out, the project engineer shall arrange for measures like underpinning, sheet piling, shoring, bracing or other similar means to support such structure and to prevent injury to any worker working adjacent to such structure or damage to property or equipment adjacent to such structure.
   (ii) Where any worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 metres above his footing, such worker shall be protected by adequate piling and bracing against such bank or side.
   (iii) The excavation and its vicinity shall be checked by a responsible person after every rain, storm or other occurrences carrying hazards and in case a hazard is noticed at such checking, adequate protection against slides and cave-in to prevent such hazard shall be provided.
   (iv) Temporary sheet piling installed for the construction of a retaining wall after excavation shall not be removed, except on the advice of the responsible person after an inspection carried out by such responsible person.
   (v) Where banks of an excavation are undercut, adequate shoring shall be provided to support the material or article overhanging such bank.

## CHAPTER 47: SAFETY WHILE WORKING AT HEIGHT

Working at height is an unavoidable situation at any site. Disabling injuries are common either due to fall of persons or falling objects. Falls are the leading cause of deaths in the construction industry. Most fatalities occur when employees fall from open-sided floors and through floor openings. There are two main categories of falls: fall from one level to another; and fall on the same level. Falls are caused mainly by persons slipping, tripping, stepping out or otherwise moving into space or they may be a consequence of the failure of a means of support. Other influencing factors can be wet, slippery or uneven surfaces, loose articles on a floor, the wearing of unsuitable footwear, lack of protection at sides and edges of elevated sites, plant or equipment, insufficient handhold or foothold, insecure supports and bad lighting.

**A. Scaffolding:**

**a) Hazards on Scaffolding:**

1. Fall of persons
2. Fall of materials and articles
3. Failure of the scaffold due to overloading
4. Failure of the scaffold members during erection and dismantling
5. Contact with energized power lines
6. Environmental

**b) Problem areas:**

1. Erecting and dismantling scaffolds.
2. Climbing up and down scaffolds.
3. Planks sliding off or breaking.
4. Improper loading or overloading.
5. Platforms not fully planked or “decked”
6. Platforms without guardrails
7. Failure to install all required components such as base plates, connections, and braces
8. Moving rolling scaffolds in the vicinity of overhead electrical wires
9. Moving rolling scaffolds with workers on the platform.

**c) Information for Employees: Before employees begin work, they must be informed by their employer:**

1. Hazards employees may be exposed to while at work;
2. Hazards employees may create which could harm other people;
3. How to minimize the likelihood of these hazards becoming a source of harm to themselves and others;
4. The location of safety equipment;
5. Emergency procedures.
6. Employers are also required to inform employees of the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

**d) Safety measures in scaffolding:**

1. The site in-charge shall ensure that
   (i) every scaffold and its components is of adequate construction with sound material and free from defects and is safe for the purposes for which it is intended for use;
   (ii) in case bamboo is used for scaffolding, such bamboo is of suitable quality, good condition, free

from protruding knots and stripped off to avoid any injury to workers;

(iii) all metal scaffolds shall conform to the relevant national standards;

(iv) no scaffold is erected, added, altered or dismantled except under the supervision of site in-charge.

(v) scaffold used in the work is maintained in good repairs and necessary measures are taken against its accidental displacement or any other hazard;

(vi) no scaffold or part thereof is partly dismantled and allowed to remain in such a condition unless-

a. the stability or safety of the remaining portion of the scaffold has been ensured by him for the safety of the such scaffold;

b. in case the remaining part of such scaffold cannot be safely used by the worker, warning notice written in Hindi and in a language understood by the majority of the workers that such scaffold is unfit for use, is displayed at the place where such scaffold is erected;

(vii) no worker is permitted to work on a scaffold which has been damaged or weakened unless adequate safety measures have been taken to ensure the safety of the worker;

(viii) warning signs are displayed at such places where repairs of scaffold is undertaken;

(ix) all necessary and practical measures for protection are taken to prevent any worker from coming into contact with the electric wires, equipment.

(x) wire net or screening net shall be provided to arrest falling objects or materials where scaffold is erected in an area where activities may pose hazards to pedestrians or vehicular traffic.

(xi) if a scaffold used by earlier employer required to be used by another employer, he shall thoroughly inspected by a responsible person the same and then use it.

(xii) if any rectification, alteration, or modification is to be made; it shall be made under the supervision of the responsible person mentioned above.

(xiii) standards of a scaffold are:

a. plumb, where practicable

b. fixed sufficiently close together to secure stability considering all possible working situations, conditions for intended use of scaffold

c. spaced as close as possible to ensure stability

(xiv) displacement of scaffold is prevented by providing sole plate or base plate.

(xv) ledgers of metal scaffolds are placed at vertical intervals with regard to safety and stability. d) Bamboo ledgers are kept as nearly as possible. They are placed and fastened to standard with due regard to safety and stability.

(*Standards:- It means a member used as a vertical support or column in the construction of scaffolds which transmits the load to the ground.*

*Ledger:-It means spanning horizontally and tying scaffolding longitudinally and which acts as a support for putlogs or transoms.*

*Putlogs:-It means a horizontal member on which the board, plank or decking of a working platforms are laid. Transoms:- It means a member placed horizontally and used to tie transversely one ledger to another, or one standard to another in an independent tie scaffold.*)

2. The height of every tower scaffold shall be less than 8 times, the lesser of the base dimension.
3. Tower scaffold is lashed to a building or a fixed structure before using it.
4. Tower scaffold which can be moved or cast is:
   (i) stable and adequately weighted at base
   (ii) used only on plain and even surface
   (iii) has casters provided with locking devices to hold it in position
5. When tower scaffold is shifted, there shall not be any worker, tools or materials.
6. Chains, ropes or lifting gears used for suspension of a scaffold are of adequate strength, sound material, suitable for the purpose and is in good maintenance.
7. Chains, wire ropes metal tubes used for the suspension of scaffold are properly and securely fastened to every anchorage point, ledgers of other main supporting members, and so positioned to ensure stability.

8. Trestle scaffold shall not be more than 3 tiers if it's working platform is more than 4.5m above the ground. It shall be designed by a professional engineer.
9. Trestle scaffold shall not be erected on suspended scaffold.
10. Jib scaffold shall be used with adequate support, fixed or anchored on opposite side of its support. - It shall have out-riggers of adequate length. - Wherever necessary it shall be supported and braced to ensure stability.
11. Working platform resting on bearers which are inside a wall on one end and other end is free without support, in such case -bearers must be of adequate strength -braced through the wall -securely fastened on the other side.
12. If a part of building is used as a support for scaffold it shall have sufficient strength and made of sound material.
13. Overhanging eaves gutters shall not be used as support.
14. Suspended scaffold shall be made as per the relevant standard.
15. A suspended scaffold shall be raised or lowered by winches or climbers only if it is made of sound material, adequate strength and tested and certified safe for use by a competent person before the start of its use.
16. All suspended scaffolds shall be properly balanced by a approved counterweight.
17. The working platform of the suspended scaffold shall be fastened to the building or structure to prevent its swinging and to make it safe.
18. Safe carrying load capacity of a suspended scaffold shall be displayed.
19. The components used to assemble scaffolds shall be inspected before each use and shall conform to requirements of this section regarding materials, strength, dimensions, etc.
20. Scaffold components manufactured by different manufacturers shall not be intermixed unless the components are compatible (fit together without mechanical force) and the scaffold's structural integrity is maintained. Scaffold components manufactured by different manufacturers shall not be modified in order to intermix them.
21. Scaffold components shall be free from detrimental corrosion.
22. Any scaffold component that is obviously damaged, excessively corroded, defective, or does not meet the applicable codes and standards shall be marked and be immediately destroyed and shall not be re-used on the project site. However, if possible, defective sections of planks or tubing may be cut off. In this case, the plank or tubing may be reused.
23. Scaffold components made of dissimilar metals shall not be used together because of the potential for galvanic corrosion.
24. Scaffold components shall not be exposed to acids or other corrosive substances, unless adequate precautions have been taken to protect the scaffold from damage.
25. Where a built-in ladder is part of a scaffold system, it shall conform to the requirements for ladders (IS: 3696, Pt-II).
26. Scaffold components shall be properly stored to prevent damage.
27. Front-end loaders, forklifts, or pieces of equipment shall not be used to support scaffolds.
28. Scaffolds shall not be hung from or supported by guardrails or handrails.
29. A crane or other lifting device shall not lift any scaffold, unless it's a Special Scaffold specifically designed for lifting and the scaffold plan was reviewed in accordance with the requirements of the standard practices.
30. Scaffold posts and frames shall be erected and maintained vertical and plumb and vertically braced in both directions to prevent swaying and displacement. Plumbness shall be checked using a spirit level, plumb bob, or by using vertical lines on an adjacent building or structure.
31. Where uplift or tension loads may occur in posts (standards) or frames (such as the back side of cantilevered scaffolds), they shall be locked together by pins (not joint pins), bolted or pinned spigots, end-to-end (sleeve) couplers, or equivalent means able to carry the tension loads.
32. Supported scaffolds with a height to the uppermost planked level that is over four times the minimum

base dimension (over a 4:1 height-to-width ratio) shall be restrained from tipping by ties, guys, outrigger frames, or equivalent means. Upper section(s) of a stepped scaffold shall not have a height over four times the width of the scaffold at the base of that section, unless ties or guys are properly installed to ensure stability.

33. Ties and guys shall be installed as follows:
    (i) ties shall be connected to buildings or structures by connecting a tie tube to at least two posts (standards) or two horizontal members (i.e., runners) and coupling this to a two-way tie, column box tie, reveal tie, or an equivalent connection.
    (ii) ties or guys shall be installed according to the scaffold manufacturer's recommendations.
    (iii) all tie connections shall be made with right-angle (double) couplers.
    (iv) Tie tubes or guys shall be installed at locations where runners (ledgers) and bearers (transoms) support the post (standard) in both directions. Tie tubes or guys shall be connected to posts as close as possible to the horizontal members, or connected to horizontal members as close as possible to the posts.
    (v) Ties or guys shall be installed adjacent to transverse vertical bracing.
    (vi) The lowest level of ties or guys shall be installed at the lift located closest to the height of 4 times the minimum base dimension (4:1 ratio).
    (vii) The uppermost level of ties or guys shall be installed as close as feasible to the top of the scaffold.
    (viii) Ties or guys shall be spaced vertically every 8 meters (26 feet) (4 lifts) or less.
34. The design of the scaffold shall take into account the following:
    (i) The strength, stability and rigidity of the supporting structure;
    (ii) The handling normally associated with scaffolding;
    (iii) The safety of persons engaged in the erection, alteration and dismantling of the scaffold;
    (iv) The safety of persons using the scaffold;
    (v) The safety of persons in the vicinity of the scaffold.
35. Foundations shall be sound, rigid, and capable of carrying the scaffold self-weight plus the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick or concrete blocks shall not be used to support scaffolds, planks, or timber sills.
36. A sound base is essential. Therefore, the ground or floor on which a scaffold stands shall be carefully examined for its load-bearing capacity. Sand or made-up ground (fill) may need compacting to ensure there are no cavities. Such bases as floors, roofs, etc., may need shoring from underneath.
37. Timber sills (sole boards) at least 225 mm (9 inches) wide by 38 millimeters (1-1/2 inches) thick shall be used to spread the load on sand, made up ground, asphalt pavement, wooden floors, and other soft or slippery surfaces. The ground beneath sills shall be level and compact. A sill shall extend under at least two posts (standards), unless not feasible because of uneven or sloping ground. In this case, sills under individual posts (standards) shall be at least 765 mm (30 inches) long. Scaffold planks shall not be used as sills.
38. All scaffold posts (standards) shall be pitched on steel base plates at least 150 millimeters (6 inches) by 150 millimeters (6 inches) and 6 millimeters (1/4-inch) thick. For Special Scaffolds, the base plate shall be designed to support the maximum scaffold post (standard) load. Timber sills shall be used where base plates may be exposed to corrosive materials.
39. Screw jacks shall be used to compensate for variations in ground level. Screw jacks shall not be adjusted to more than two-thirds of the total length of the threaded section. Screw jacks shall be used and loaded in accordance with the manufacturer's specifications.
40. When scaffolds are supported on the ground, suitable sole plates must be used to spread the load. The sole plates shall preferably be long enough to support at least two standards. Timber sole plates must be not less than 200 x 38 x 500 mm long. Bricks, blocks and similar loose material are unsuitable as they are liable to fall over or split, and are easily driven into the ground.
41. Where the foundation is leveled concrete of adequate thickness or of a similar hard surface, the sole plate may be omitted, but steel base plates must be provided at the bottom of all standards.

42. The decked width must be not less than 700 mm, with sufficient additional width to leave 450 mm minimum clear walkway at all times. The distance between the outer edge of the platform to be guarded and the projection of the inner vertical face of a guardrail must not exceed 200 mm.
43. Scaffold planks must be so placed, locked or secured as to prevent tipping or displacement during normal use, or movement by strong wind. End overhang must be 80 mm minimum to 220 mm maximum.
44. It is good practice to butt planks in a decked platform. When butted, each end bearing shall be not less than 75 mm. When lapped, the amount of overlap must be not less than 150 mm. Decking planks which are lapped must be fitted with wedge cleats or fillets to reduce the risk of tripping or facilitate the wheeling of loads.
45. Every working platform must be decked as close as practicable to the working face of the structure it is being used with. Where the height is greater than 3 m, a guardrail or other protection must be provided within 200 mm of the outer edge of the plank.
46. Guardrails, including mid-rails, must be provided on the exposed sides and ends of all working platforms more than 3 m in height. The height to the top of the guardrail must be not less than 0.95 m or more than 1.1 m from the deck to be protected.
47. A mid-rail is required on a working platform which shall be placed exactly half of the height of the top rail.
48. Each rail, when secured to the standards or upright members, must be capable of sustaining without failure or undue deflection a force at any point of 70 kg (690 N) vertical and horizontal, acting separately.
49. A toe-board of 150 mm minimum height shall be provided for protection against fall of materials from the platform.
50. Where the scaffold platform is above a public thoroughfare, and due to the nature of the work falls of material are possible with injury to passers-by, special precautions must be taken. Special protection may consist of:
    (i) Screening the working platforms with robust screens or steel mesh to a height of at least 1 m. The mesh opening shall not exceed 50 mm.
    (ii) Providing catch screens where the horizontal distance from the scaffolding is more than half the vertical distance between the screen and the middle of the topmost working platform of the scaffold.
    (iii) Containment sheeting may be used to provide protection to the public from the construction works being carried out or to provide weather protection for construction workers working on or about the scaffolding.
    (iv) Containment sheeting increases the dead load on the scaffold, and greatly increases the wind load on the scaffold. It is unlikely that black wire ties commonly used to tie scaffolds will be sufficient where containment sheeting is used. For this reason it is essential that scaffolds that are to be sheeted be designed and approved by a competent person such as a registered engineer experienced in scaffold design.
51. Plan Bracing: Where the horizontal tie spacing cannot be complied with, plan bracing shall be provided. Even with this bracing provided, the maximum horizontal distance between tie points shall not exceed 10 m.
52. Dogleg Bracing: Where it is impracticable to fit ties at the vertical spacing specified, dogleg bracing shall be provided. With such bracing the distance between tie points shall not exceed 8.4 m or 4 lifts.
53. Diagonal Bracing: Longitudinal diagonal bracing must be fixed to the external face of the scaffold, and at regular intervals along its length. The bracing, which is required to resist wind and earthquake forces in particular, must be capable of withstanding a horizontal force of not less than one-tenth of the total of the weight of the scaffold and the full live load on the working platforms. Some methods of arranging diagonal bracing for scaffolds are illustrated.
54. Cross Bracing: Scaffolds are to be provided with cross bracing at each stage to take care of diagonal/shear load acted on it.

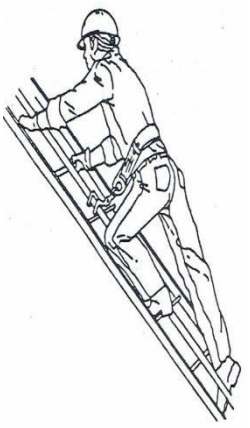
55. Clearance from Electrical Lines & Scaffolds: Hoisting scaffold material by forklift or other mechanical means requires careful planning and shall be avoided in the vicinity of power lines. Workers handling materials or equipment while working on the platform must also take care to avoid electrical contact. The required minimum safe distances are listed in the **Table given at Clause 'B' Chapter 74 can be taken for reference.**
56. Assign a responsible person to oversee the scaffold selection, erection, use, movement, alteration, dismantling, maintenance and inspection.
57. Assign only trained and experienced personnel to work on scaffolding.
58. Be certain they are knowledgeable about the type of scaffolding to be used and about the proper selection, care and use of fall protection equipment (perimeter protection, fall protection/work positioning belts and full harnesses, lanyards, lifelines, rope grabs, shock absorbers, etc.).
59. Employees shall receive instruction on the particular types of scaffolds that they are to use.
60. Training shall focus on proper erection, handling, use, inspection, removal and care of the scaffolds.
61. Training must include the installation of fall protection, particularly guardrails, and the proper selection, use and care of fall arrest equipment.
62. The competent person(s) shall receive additional training regarding the selection of scaffolds, recognition of site conditions, scaffold hazard recognition, protection of exposed personnel and the public, repair and replacement options, and requirements of standards.
63. Site management personnel shall also be familiar with correct scaffolding procedures so they can better determine needs and identify deficiencies.

**B. Ladders:**

a) **Causes of falls with or from ladders include:**

1. failure, to lash securely where necessary or to have a person stationed at the foot;
2. failure to place on proper footing; failure to rest ladder against a firm support;
3. using a ladder at a dangerous angle of incline;
4. not facing the ladder when climbing or descending;
5. allowing rungs to become greasy;
6. overloading (accidents have been caused "by having too many people on a ladder at once);
7. carrying bulky materials when a hoist line shall be used;
8. use of a ladder which is in an unsafe condition;
9. overreaching on a ladder when it ought to be moved to another position;
10. ladder not extending beyond support or adequate handholds for climbing off or on ladder not provided;
11. Using ladder for purposes other than intended.

**b) Safety measures for use of ladder:**



1. Ladders used in work shall be of good construction, sound material and of adequate strength.
2. Ladder used shall be placed in firm, level and hard surface.3. Defective ladder shall not be used for any work.
3. Ladders with missing or defective rungs and broken style shall be discarded.
4. In case of use of fixed ladders, sufficient foot-hold and hand-hold shall be provided for use.
5. Ladder shall be placed as nearly as possible at an inclination of four in one.
6. Width of ladders shall be equal and not less than 25 cm or more than 35 cm to avoid deflection.
7. Rungs of metal ladders shall be kept clean before use to prevent slip.
8. Portable ladders shall not exceed 9 m in length.
9. Every ladder or run of ladders rising to a height exceeding 9 m shall be provided with an intermediate landing, providing further that the intervals between landings shall not exceed 9 m. The landings shall be of suitable size and protected by railings.
10. Every ladder shall rise at least 1 m above the highest point to be reached and have one of the uprights continued to that height to serve as a hand-rail at the top.
11. Metal ladders shall be protected against corrosion by being coated with rust-proof paint or by other means unless they are made of non-corrosive metals.
12. Metal ladders shall not be used in the vicinity of live electrical equipment.
13. A ladder shall not be placed in front of a door or window that opens towards it unless the door is fastened or locked or guarded.
14. Every ladder shall be securely fixed to avoid any displacement and if it is not possible a person shall be provided to hold the ladder at the bottom to prevent it from slipping.
15. While climbing worker shall avoid carrying loads, face the ladder and avoid wearing slippery footwear.
16. Workers using ladders shall maintain three point contact i.e. two leg and one hand or two hand and one leg.
17. The length of extension ladders shall not exceed 15 m.
18. Extension ladders shall be equipped with an effective lock and guide brackets by which the ladder can be extended, retracted or locked in any position.
19. The rungs of overlapping sections shall coincide so as to form double treads and shall be equipped with one or more extension ropes.
20. Extension ropes shall be securely anchored and run over suitable pulleys.
21. The overall length of the extension ladder shall not exceed 18 m.
22. The sliding section shall not exceed two in number.
23. Locks and guides shall be of such design and construction as to make the extension ladder equal in strength to a ladder of equal length constructed of continuous slide rails.
24. Platform of scissor ladder shall be provided with guard-rails and toe-board.
25. Scissor ladders shall not be traveled while a person is on the platform.
26. Fixed ladders shall be firmly bolted or welded to the structure.

.27. Ladders shall not be used in horizontal position as runways or crossover.
28. The design of ladder shall confirm to IS 3696 (Part 2): 1991. Make shift ladders shall not be permitted.
29. Metal ladder shall be either of steel complying with IS-1977:1975, or of aluminum alloy complying with the suitable grade of IS-617:1975.
30. Overall length of stock ladders shall not exceed 10 m.
31. The width between side rails at the base shall in no case be less than 290 mm for ladders upto 3 m in length. In the case of metal ladders, metal rungs shall be made of solid round steel rods or steel pipe and securely fastened to the slide rails by riveting, bolting or welding.
32. The overall height of step ladders shall not exceed 6 m.
33. Ladders shall be provided with an automatic locking device or spreader to hold it in an open position.
34. The minimum width between side rails at top step, inside to inside, shall be not less than 300 mm with a spread of 25 mm for each 300 mm of length of spread ladder.
35. Trestle ladders shall not exceed 6 m in length.
36. The sections shall be so hinged at the top that when the trestle ladder is spread, they form equal angles with the base.
37. The rungs shall not be less than 30 mm in diameter shall be spaced not more than 450 mm apart centre to centre in trestle ladder.
38. The minimum distance between side-rails of trestle ladders shall be not less than 300 mm.
39. A locking device or spreader shall be provided to hold the front and back sections securely in an open position in trestle ladder.
40. All surfaces of the Built up ladder (Fixed Ladder) shall be plane, free of splinters and edge of hand rails used shall be beveled.
41. Rung spacing shall be uniform and not over 300 mm on centres. Rungs shall be recessed at least 12 mm into rails / stiles in built- up ladder.
42. When height exceeds 9m, landing platform to be provided inbuilt- up ladder.
43. Top and bottom of built-up ladder shall be securely fastened to the structure.

**C. Working platforms:**

1. Platforms of scaffolds shall be of adequate width, kept free of unnecessary obstructions and tripping risks, guarded where necessary at the sides and edges and frequently inspected, especially in wet or frosty weather.
2. Working platforms shall be of sound material, good construction, possesses adequate strength and uniform size.
3. Designed safe working load shall be clearly displayed on the working platform for information of the worker.
4. All members of working platform shall be properly fastened.
5. Guardrails and toe board shall be provided at the working platform with safe means of access and egress.
6. The floor of working platform shall be nonskid and free from oil, grease etc.
7. Movement from one working platform to another shall be provided with safe means of access.
8. Storing of materials and debris shall not be allowed at the working platform except quantity required for performing the work.
9. Working platform is provided around the face/ edge of the building adjoining - at every uppermost permanent floor of the building under construction - at any level where construction work such building is carried out.
10. A platform is designed to suit:
    (i) the number of building workers working on each bay - the material, articles, tools carried by them in such bay,

(ii) The safe working load and the no. of workers to be employed in each bay must be displayed. Board, plank,

11. Decking used for working platform is
    (i) of uniform size, strength and capable of supporting the workers and load as per national standard;
    (ii) metal decking shall be of non- skid surface
12. Board or plank used for making platform shall not project beyond its end support. If it is projecting out, then it shall be effectively prevented from tripping or lifting.
13. Board, plank, decking is fastened and secured.
14. At any one time maximum two working platform per bay shall be used to support workers, material etc.
15. Use safety net or similar method to prevent injury from falling material.
16. Concrete and other debris shall not be accumulated on any platform.
17. If work is to be done up to the end of wall, work platform shall be faced or extended by 0.6 meter.
18. Ensure that:
    (i) Workers shall not go on damaged or weak scaffold. Take adequate safety measures then only send workers on such scaffold.
    (ii) When repair of scaffold is undertaken, necessary warning sign shall be displayed.
    (iii) There shall be no opening in any working platform (Exception- access to the platform)
    (iv) If openings are unavoidable, necessary protection against falling of material/ workers such as nets, belts etc.
    (v) Suitable safe ladder shall be provided for accessing from one platform to other platform.
    (vi) Suitable guardrail and toe board is provided to prevent fall of building workers, material, tools, from any platform provided on scaffold.

**D. Fall arresting equipment:**

1. Wherever any work at a height of more than 2 m is carried out, use of a suitable fall arrest system such as full body safety harness, lanyard, lifelines is mandatory if the workplace has not been provided with safety net.
2. The supervisor shall ensure that full body safety harness, lanyard and lifelines are fit for use before taking them into use.
3. Safety net used for fall arrest system shall be of adequate strength and made of sound material.
4. Full body safety harness, lanyard, life lines and devices for the attachment of such life lines shall conform to the national standards.
5. Every safety net shall be of adequate strength, made of sound material and is suitable for use and conform to the national standards.
6. The responsible person for maintenance of safety nets and their use shall ensure safe fixing of such safety nets and provides such safety nets with suitable and sufficient anchorage so that the purposes for which such safety net is intended for use is served.
7. Proper arrangement shall be made for the safe storage of full body safety harness, safety lifelines and safety nets when they are not in use and are protected against mechanical damage, damage from chemicals and damages from biological agents.

**E. Floor openings:**

1. Any opening in a floor, ground, fixed vessel, sump, tank or pit which is or may be a source of danger by reason of its depth, situation, construction or contents shall be either securely covered or securely fenced.
2. Wherever opening on a floor is unavoidable for the purpose of maintenance work, necessary measures for protection against falling of workers are taken by providing barricade tape and other suitable means.

**F. Protections against fall of persons:**

1. Working platforms at height of 2metres or more and floor openings shall be properly fenced with guardrail and toe board of sound material, good construction, possesses adequate strength and free from sharp edges and be minimum 1 metre height from the platform level.
2. Guardrail shall be provided with top rail, intermediate rail and bottom rail and toe board shall be minimum 10 cm.
3. If floor opening is provided with cover, it shall be adequately strong for any kind of traffic and flush with the floor.
4. If cover is provided with bars, angle or I-section, the gap shall not be more than 5 cm and arrangement for fitting and fixing shall be made to prevent any displacement.
5. Pits, trenches and openings in open area shall be properly fenced with solid materials with sound construction to avoid fall of person or animals.
6. If the fencing or guarding is removed for any work the same shall be replaced as soon as the work is over.
7. Safe means of access and egress such as stairs or ladders shall be provided at elevated platform.
8. Full body safety harness with lanyard shall be used while working at elevated platform.
9. Barriers shall be placed alongside excavations whenever possible to prevent accidental falls into them;
10. Suitable gangways shall be provided for crossing an excavation since there is a tendency for people to try to jump over and across an excavation if no other way is conveniently near.
11. Provide and keep all steps or other means of access on to vehicles in good repair and free of mud or grease;
12. Workers shall not be allowed to ride on such plant, unless there is safe accommodation. There shall be a prohibition of riding on tow bars, steps, running boards and dumper skids.
13. Safe access shall be provided for drivers and for people engaged in lubrication, repair work, examinations or inspections ;
14. Platforms for drivers or signalers shall have suitable barriers to prevent falls or safety belt.
15. Falls down hoist ways shall be prevented by suitable enclosure of the hoistway. Gates at landing level shall never be open unless the platform or cage is stationary there;
16. No person shall travel in a hoist, erected for the work on the site, unless it is of safe construction and has a cage with interlocked gates.

**G. Protection against fall of materials:**

1. Working area shall be properly barricaded and no worker shall be allowed to enter or perform any work below the area where working at height is going on.
2. Person safety net or debris safety net shall be provided where necessary.
3. Unauthorized persons shall not be allowed to access to work sites.

**H. Temporary stairs:**

a) Temporary staircase has to be sturdy and well designed for the safety of the employees who have to reach heights or access areas. Employees shall be safe & not fall from such temporary stairs. Internal stairs shall be constructed of non-combustible materials throughout. Internal stairs shall be constructed as a self-contained unit with an external wall of the building constituting at least one of its sides and shall be completely enclosed. A staircase shall not be arranged round a lift shaft. Hollow combustible construction shall not be permitted. No gas piping or electrical panels shall be allowed in the stairway. Ducting in stairway may be permitted if it is of 1 hour fire resisting rating. Notwithstanding the detailed provision for exits minimum width shall be provided for staircases:

1. Residential buildings (dwellings): 1.0 m
2. Residential hotel buildings: 1.5 m
3. Assembly buildings like auditorium, theatres and cinemas: 2.0 m
4. Educational buildings up to 30 m: 1.5 m height
5. Institutional buildings like hospitals: 2.0 m
6. All other buildings: 1.5 m

b) The minimum width of treat without nosing shall be 250 mm for internal staircase of residential buildings. This shall be 300 mm for assembly, hotels, educational, institutional, business and other buildings. The treads shall be constructed and maintained in a manner to prevent slipping. The maximum height of riser shall be 190 mm for residential buildings and 150 mm for other buildings and the number shall be limited to 15 per flight. Handrails shall be provided at a height of 1000 mm to be measured from the base of the middle of the treads to the top of the handrails. Balusters / railing shall be provided such that the width of staircase does not reduce.
The number of people in between floor landings in staircase shall not be less than the population on each floor for the purpose of design of staircase.

c) The design of staircase shall also take into account the following:

1. The minimum headroom in a passage under the landing of a staircase and under the landing of a staircase and under the staircase shall be 2.2 m.
2. For building 15 m in height or more, access to main staircase shall be through a fire / smoke check door of a minimum 2 hour fire resistance rating. Fire resistance rating may be reduced to 1 hour for residential buildings (except hotels and starred hotels).
3. No living space, store or other fire risk shall open directly into the staircase or staircases.
4. External exit door of staircase enclosure at ground level shall open directly to the open spaces or through a large lobby, if necessary.
5. The main and external staircases shall be continuous from ground floor to the terrace level.
6. No electrical shafts / AC ducts or gas pipes, etc. shall pass through or open in the staircases. Lifts shall not open in staircase.
7. No combustible material shall be used for decoration/ wall paneling in the staircase.
8. Beams / columns and other building features shall not reduce the head room / width of the staircase.
9. The exit sign with arrow indicating the way to the escape route shall be provided at a suitable height from the floor level on the wall and shall be illuminated by electric light connected to corridor circuits. All exit way marking signs shall be flush with the wall and so designed that no mechanical damage shall occur to them due to moving of furniture or other heavy equipment. Further, all landings of floor shall have floor indicating boards prominently indicating the number of floor as per bye-laws.
10. The floor indication board shall be placed on the wall immediately facing the flight of stairs and nearest to the landing. It shall be of size not less than 0.5 m X 0.5 m.
11. Individual floors shall be prominently indicated on the wall facing the staircases.
12. In case of single staircase it shall terminate at the ground floor level and the access to the basement shall be by a separate staircase. The second staircase may lead to basement levels provided the same is

separate at ground level by ventilated lobby with discharge points to two different ends through enclosures.

d) An external staircase is desirable to be provided for high rise buildings. External stairs, when provided shall comply the following:

1. External stairs shall always be kept in sound operable conditions.
2. All external stairs shall be directly connected to the ground.
3. Entrance to the external stairs shall be separate and remote from the internal staircase.
4. Care shall be taken to ensure that no wall opening or window opens on to or close to an external stairs.
5. The route to the external stairs shall be free of obstructions at all times.
6. The external stairs shall be constructed of non-combustible materials, and any doorway leading to it shall have the required fire resistance.
7. No external staircase, used as a fire escape, shall be inclined at an angle greater than 45 degree from the horizontal.
8. External stairs shall have straight flight not less than 1250 mm wide with 250 mm treads and risers not more than 190 mm. The number of risers shall be limited to 15 per flight.
9. Handrails shall be of a height not less than 1000 mm and not exceeding 1200 mm. There shall be provisions of balusters with maximum gap of 150 mm.

e) The use of spiral staircase shall be limited to low occupant load and to a building not exceeding 9 m in height. A spiral stair case shall be not less than 1500 mm in diameter and shall be designed to give adequate headroom. Unprotected steel frame staircase will not be accepted as means of escape. However, steel staircase in an enclosed fire rated compartment of 2 hour will be accepted as means of escape.

I. Suspended Jhoolas:

Suspended access for external work is normally being done by Jhoolas where in one person sits on a plank which is lowered from the top and held manually by ropes. Such practice is highly dangerous. With safety equipment like Boatswain's chair shall use for safety of the employees. Suspended Jhoolas if being used, the rope used to suspend the worker has to be of adequate strength and shall be inspected regularly for wear and tear. The rope end has to be anchored on the top to fasten & hold the weight of the person. Training shall be imparted to the person controlling the vertical movement of the Jhoola and shall have appropriate physical strength to control & hold the weight or if possible winch system to be used. A vertical lifeline has to be used for additional safety in addition to the Full body harness.

## CHAPTER 48: SAFETY DURING EXCAVATION AND TUNNELING WORK

### A. Causes of accident from excavation work:

The main causes of accidents resulting from excavation work are as follows:

1. Workers trapped and buried in an excavation owing to the collapse of the sides;
2. Workers struck and injured by material falling into the excavation;
3. Workers falling into the excavation;
4. Unsafe means of access and insufficient means of access in case of flooding;
5. Vehicles driven into or too close to the edge of an excavation, particularly while reversing, causing the sides to collapse;
6. Asphyxiation or poisoning caused by fumes heavier than air entering the excavation, e.g. exhaust fumes from the diesel and petrol engines.

### B. Safety Precautions:

1. The employer or owner shall within thirty days prior to the commencement of excavation or tunneling work, inform in writing the detailed layout plans, method of construction and schedule of such excavation or tunneling work to the Director General of Inspection or chief Inspector of Inspection.
2. A register for entry and exit shall be kept and strictly maintained at the entrance of excavation or tunneling work.
3. In case compressed air is used in such excavation or tunneling work or any work incidental to or required for such excavation or tunneling work, the technical details and drawings of all man-locks and medical-locks together with names and addresses of all construction medical officers and so appointed for the purpose of such excavation or tunneling work shall be sent to the Director General of Inspection or chief Inspector of Inspection.
4. Every employer or owner undertaking any excavation or tunneling work shall appoint a project engineer for safe operation of such projects.
5. Such project engineer shall exercise overall control of the operations and the activities at such project and be responsible for carrying out the activities safely.
6. Every employer or owner undertaking excavation or tunnel ling work at a construction site of a building or other construction work shall appoint a responsible person for safe operation of such excavation or tunneling work.
7. The name and address of such responsible persons shall be forwarded to the Director General of Inspection or chief Inspector of Inspection.
8. Duties and responsibilities of the responsible person shall include:
   (i) to carry out smoothly such excavation or tunneling work;
   (ii) to inspect and rectify any hazardous situation relating to such excavation or tunneling work;
   (iii) to take remedial measures to avoid any unsafe practice or conditions relating to such excavation or tunneling work.
9. Suitable warning signs or notices, required for the safety of workers carrying out the work of an excavation or tunneling, shall be displayed or erected at conspicuous places in Hindi and in language understood by the majority of such building workers at such excavation or tunneling work.
10. Such warning signs and notices with regard to compressed air working shall include:
    (i) the danger involved in such compressed air work;
    (ii) fire and explosion hazards;
    (iii) the emergency procedures for rescue from such danger or hazards.
11. The employer shall ensure that at a construction site of a building or other construction work where an excavation or tunneling work is being carried on, a register of employment of building workers carrying out such excavation or tunneling work, is maintained and produced on demand to the inspector.

12. Periods of work of such excavation or tunneling work shall be maintained in a register on day-to-day basis and such register shall be produced on demand to the inspector.
13. Every employer carrying out excavation or tunneling work at a construction site of a building or other construction work shall be adequately illuminated and provide for emergency generators on such construction site to ensure adequate illumination in case of power failure.
14. Where there is any doubt as to the stability of any structure adjoining the workplace or other areas to be excavated or where tunneling work is to be carried out, the project engineer shall arrange for measures like underpinning, sheet piling, shoring, bracing or other similar means to support such structure and to prevent injury to any worker working adjacent to such structure or damage to property or equipment adjacent to such structure. Wherever possible, an excavation shall not be so close and deep as to undermine any building or structure.
15. Where any worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 metres above his footing, such worker shall be protected by adequate piling and bracing against such bank or side.
16. The excavation and its vicinity shall be checked by a responsible person after every rain, storm or other occurrences carrying hazards and in case a hazard is noticed at such checking, adequate protection against slides and cave-in to prevent such hazard shall be provided.
17. Temporary sheet piling installed for the construction of a retaining wall after excavation shall not be removed, except on the advice of the responsible person after an inspection carried out by such responsible person.
18. The sides of the excavation or trench shall be sloped or battered back to a safe angle of repose, usually 45 degree, or be supported by timbering or other suitable means to prevent a collapse. The type of support necessary will be depending on type of excavation, the nature of ground and the ground water conditions.
19. Where banks of an excavation are undercut, adequate shoring shall be provided to support the material or article overhanging such bank.
20. Excavated material shall not be stored at least 0.65 metres from the edge of an open excavation or trench and the banks of such excavation or trench shall be stripped of loose rocks and other materials which may slide, roll or fall upon a worker working below such bank.
21. Adequate and suitable warning signs shall be put-up at conspicuous places at the excavation work to avoid any person falling into the excavations or trenches.
22. The responsible person shall ensure at the excavation work that no worker is permitted to work where such worker may be struck or endangered by the excavation machinery or material or article used in such excavation.
23. Ladders, staircases or ramps shall be provided, as the case may be, for safe access to and egress form excavation where the depth of such excavation exceeds one point 1.5 metres and such ladders, staircases or ramps comply with the relevant national standards. Ladders, if used, shall be constructed, used, maintained and inspected in accordance with the requirements laid down in IS: 3696 (Part 1&2 Safety code for Scaffoldings & Ladders).
24. A trench or excavation shall be protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 metres and such protection shall be an improved protection in accordance with the design and drawing of a Professional Engineer, where such depth exceeds 4 metres.
25. Where the depth of a trench requires two lengths of sheet piling, one above the other, the lower piling shall be set inside the bottom strings or wales of the upper piling and such sheet piling shall be driven down and braced as the excavation continues.
26. All metal sheet piles used in excavation or a trench shall be welded end-to-end and secured by other similar means.
27. Any machinery used in excavation and tunneling work shall be positioned and operated in such a way that such machinery shall not endanger the operator of such machinery or any other person in the vicinity.

28. Suitable breathing apparatus shall be provided to a worker while working in compressed air environment for his use at excavation or tunneling work and such breathing apparatus shall be maintained in good working condition at all times.
29. Where there is a danger of falling or sliding of material from the roof face or wall of a tunnel, adequate measures such as shoring, supporting by means of rock bolts, segments or steel sets shall be taken for the safety of the workers.
30. The excavated areas shall be made safe by use of suitably designed and installed steel sets, rock bolts or similar other safe means.
31. Before start of open excavation, a sound curb wall to be build in such a shape and at such a distance from excavation line so that the boulders rolling down from the uphill side do not fall in the excavation area. The procedure will also provide a kind of retaining protection against landslide and contain & divert the soil mass, boulders etc., to a side away from excavated area.
32. Wherever, loose soil / clay is encountered, shoring shall be done for all excavations.
33. undercutting shall be avoided reasonably.
34. Approval quality of wood shall be used for shoring. Any other structural material having strength not less than that of the approved wood may also be used for the purpose.
35. It shall be ensured that no nails / sharp edges are protruding out of shoring arrangement to cause injury to workers.
36. The supervisor shall inspect shoring arrangements used therein before work is started and after explosives have been used in or near the excavation or earthwork.
37. After every blasting operation, the supervisor of the site shall carefully examine the side slopes of excavations to prevent rock falls / splits.
38. Work at the excavations shall not commence until all loose rock on the sides is the first removed. All workers engaged in such excavations shall use safety helmets and safety shoes all the time.
39. For more details regarding shoring and timbering, please refer IS:3764, code of safety for excavation works.
40. All loose stones, projecting clumps of earth, pockets of unstable material on sides of the excavation shall be either removed or excavated sides adequately braced and the bench suitably guarded.
41. On steep slopes workmen shall not be permitted to work one above the other.
42. Material shall not be piled against the walls as this may endanger the walls.
43. The excavation tools or material, such as wheelbarrows, shovels, picks, tiles, cement, lumber etc. shall kept far enough from the edge of the bench to prevent their being inadvertently knocked in to the lower bench.
44. Pathways shall be non-slippery and of adequate width (not less than 75 cm).
45. Wherever pathways, gangways are suspended, these must have guardrails and side supports on both sides to prevent fall of workmen into the excavation.
46. Adequate lighting shall be provided at excavation area for night works.
47. Flame-proof electrical installations shall be used where inflammable substances are stored or present. Portable lamps/ flashlights, if required, shall be of flame-proof type only.
48. When a workman is required to enter hazardous slopes or to scale rock from the side slopes, a safety rope shall be securely tied to the safety belt worn by him so that, if necessary, he may be assisted or drawn to safety.
49. Lifelines shall be secured to at least two substantial anchorages or structural members. Manila lifelines, used for supporting personnel on safety belts, shall be at least 20 mm in diameter and shall have a wire core.
50. Overhangs, if any, shall be removed before further material is taken from that part.
51. The responsible person shall examine and inspect the workplaces in a tunnel before the commencement of work in such tunnel, and at regular intervals thereafter, to ensure safety of the building workers in such tunnel.
52. The portal areas of a tunnel with loose soil or rock, likely to cause injury to a person shall be adequately protected with supports.

53. Supply lines to pneumatic tools used within a tunnel shall be fitted with water trap or safety chain or safety wire, as the case may be.
54. Surroundings of a shaft used in excavation or tunnel work shall be protected from being washed away by construction of sufficient height.
55. Where a building worker is required to enter a shaft at an excavation or tunneling work, safe means of access shall be provided for such entry.
56. Every shaft at excavation or tunneling work shall be provided with a steel casing, concrete piping, timber shoring or other materials of adequate strength for the safety of workers working in such shaft.
57. Such casing and bracing shall be provided to a shaft at an excavation or tunneling work up to the depth of such shaft according to the appropriate design for such casing and bracing.
58. A reinforced concrete raft and beam shall be provided around the opening of a shaft at an excavation or tunneling work if the ground surrounding such opening is unstable or unsafe.
59. Lift shall be provided for transport of workers and materials or articles at an excavation or tunneling work required to descend more than 50 metres in a shaft.
60. Reliable and effective means of communication such as telephone or walkie-talkie shall be provided and maintained in working order for arranging better and effective communication at an excavation or tunneling work at the following locations, namely:-
    (i) Working chamber at the face of an excavation;
    (ii) Intervals of hundred meters along the tunnel;
    (iii) Working chamber side of a man lock near the door of such man lock;
    (iv) Interior of each chamber of a man lock;
    (v) Location conspicuous a lock attendant's station;
    (vi) A compressor plant;
    (vii) A first-aid station, and
    (viii) Outside the portal or the top of a shaft.
61. Bells and whistles at sufficient numbers shall be made available at all times at the locations mentioned above as are necessary for the safety of persons at such locations.
62. The standard audio or video signals shall be used in excavation or tunneling work and shall be conspicuously located or displayed near entrance to the workplace and in such other locations as may be necessary to bring such signals to notice of all workers employed in such excavation or tunneling work.
63. The minimum lateral clearances of half a metre shall be maintained between any part of a vehicle and any fixture or any equipment used in an excavation or tunneling work after allowing the throw or swing of such fixture or equipment.
64. The overhead clearance for a locomotive drive at excavation or tunneling work shall not be less than 1.10 metres above the seat of such driver and not less than 2 metres above the platform where such driver stands or of any other dimension in accordance with the relevant national standard.
65. The adequate number of shelters for the safeguard of the workers shall be provided where, in the course of working, they are liable to be struck by a moving vehicle or other material handling equipment in a tunnel.
66. No internal combustion engine shall be used underground in excavation or tunneling work unless such engine is so constructed that the air entering the engine gets cleared before entry and no fumes or sparks shall emits by the engine.
67. Inflammable oils with the flash point below the working temperature that is likely to be encountered in a tunnel shall not be used in excavation or tunneling work.
68. Only high-pressure hydraulic hoses and couplings shall be used on hydraulic plants underground and such high-pressure hydraulic hoses and couplings shall be adequately protected against any possible damage in excavation or tunneling work.
69. All hydraulic lines and plants working at a temperature exceeding 70 degree centigrade shall be protected by adequate insulation or otherwise against accidental human contact in excavation or tunneling work.

70. No fire hydraulic hoses other than fire resistant hydraulic hoses shall be used when hydraulically activated machinery and equipment is employed in tunnels.
71. Only flame proof equipment of appropriate type as per relevant national standards shall be used where there is a danger of flammable or explosive atmosphere being prevalent inside the tunnel.
72. All oils, greases or fuels stored underground in excavation or tunneling work shall be kept in tightly sealed containers and in fire resistant areas at safe distances away from explosive and other flammable chemical and appropriate flameproof installation shall be used in such storage areas.
73. Petrol or liquefied petroleum gas or any other flammable substances shall not be used, stored inside the tunnel except with the prior approval of the Project Engineer.
74. After the use of the petroleum or liquefied petroleum gas or highly inflammable substances, all remaining petroleum or liquefied petroleum gas or highly inflammable substances shall be removed immediately from such tunnel.
75. No oxy-acetylene gas shall be used in a compressed air environment in excavation or tunneling work.
76. Adequate number of water outlets shall be provided on excavation or tunneling work and shall readily made accessible throughout the tunnel for firefighting purposes and such water outlets shall be maintained for effective firefighting.
77. All air locks shall be equipped with firefighting facilities at excavation or tunneling work.
78. An audible fire alarm shall be provided to warn the workers whenever a fire breaks out on an excavation or tunneling work.
79. Adequate number and types of fire extinguishers, in accordance with relevant national standards, shall be provided and made readily available to fight any outbreak of fire at an excavation or tunneling work.
80. Fire extinguishers with vaporizing liquids and high pressure carbon dioxide shall not be used in tunnels or other confined spaces.
81. The instructions regarding steps to be followed to fight outbreak of fire, at an excavation or tunneling work, written in Hindi or local language understood by the majority of the workers employed on such excavation or tunneling work, shall be displayed at conspicuous and vulnerable places of such excavation or tunneling work.
82. Water tight bulkhead doors shall be installed at the entrance of a tunnel to prevent flooding during a tunneling work where more than one tunnel is driven from a shaft.
83. All necessary measures shall be taken to ensure that no building worker is trapped in any isolated section of a tunnel when any bulkhead door of such tunnel is closed.
84. Where there is likelihood of flooding or water rushing into a tunnel during a tunneling work, arrangements shall be made for immediate starting of water pumps to take out water of such flooding or water rushing and for giving alert signals to the workers and other persons to keep them away from danger.
85. Airtight steel curtains shall be provided in areas liable to flooding at tunneling work and in case of descending tunnels, such curtains shall be provided in the top half of such tunnels to ensure the retention of pockets of air for rescue purpose.
86. Where building workers employed in a compressed air environment in a tunneling work are required to remain at the work site for one hour or more after decompression from pressure exceeding one bar, adequate and suitable facilities shall be provided for such building workers to rest.
87. Every man-lock, medical-lock and any other facility inside these locks in a tunneling work shall be maintained in a clean state and in good repairs.
88. A first-aid room shall be provided and readily available at a construction site of a tunneling work.
89. Each man-lock attendant station shall be provided with a first-aid box.
90. The working environment in a tunnel or a shaft in which workers are employed shall not contain any of the hazardous substances in concentrations beyond the permissible limits.
91. The responsible person shall conduct necessary test before the commencement of a tunneling work for the day and at suitable intervals as fixed by the Engineer in-charge, to ensure that the permissible

limits of exposure are not exceeded and a record of such test shall be maintained and made available for inspection.

92. All working areas in a free air tunnel shall be provided with the approved ventilation system and the fresh air supplied in such tunnel shall not be less than 6 cubic metres per minute for each worker employed underground in such tunnel and the free airflow movement inside such tunnel shall not less than 9 cubic metres per minute.
93. The air intake points for all air compression shall be located at places where such intake air does not get contaminated with dust, fumes, vapor and exhaust gases or other contaminants.
94. Every compressed air system in a tunnel shall be provided with emergency power supply system for maintaining continued supply of compressed air in such compressed air system and shall be capable of operating air compressor and ancillary systems of such compressed air system.
95. The emergency power supply system shall be maintained and made readily available at all times.
96. Every air-main supplying air to the working chamber, man-lock or medical lock used at an excavation or tunneling work shall be protected against accidental damage and where it is not practicable to provide such protection, a stand-by air main shall be provided.
97. A bulk head or air tight diaphragms retaining compressed air, when used within a tunnel or a shaft, shall be constructed to withstand the maximum pressure at 1.25 times the maximum working pressure of such bulk head or diaphragm and such bulk head or diaphragm shall be tested before its each use by a responsible person to ensure that such bulk head or diaphragm is in proper working order.
98. Such responsible person shall keep the record of each test and such record shall be produced for inspection.
99. The bulk head or diaphragm shall be made of sound material of adequate strength and shall be able to withstand to maximum pressure on which they are subjected to at any time of their use.
100. A bulkhead anchorage and air lock shall be tested at its work place at an excavation or tunneling work immediately after their installation at such place.
101. All diaphragms, which are in the form of horizontal decks across a shaft used at excavation or tunneling work, shall be securely anchored.
102. All portable electrical hand tools and inspection lamps used underground or in a confined space shall be operated at a voltage not exceeding 24 Volts.
103. Adequate numbers of differential ground fault circuit breakers shall be installed for every electrical distribution system and its sub-systems used at an excavation or tunneling work and the sensitivity of each of circuit breaker shall be adjusted in accordance with the requirement set out in accordance with the relevant national standards.
104. No semi-enclosed fuse unit shall be used in underground place an excavation or tunneling work.
105. No transformer shall be used in any section of a tunnel under compressed air unless such transformer is of the dry type and conforms to the relevant national standards.
106. There shall be no exposed live wire in working areas at an excavation or tunneling work which is accessible to workers other than those authorized to work on such live lines.
107. All welding sets used in a tunnel shall be of adequate capacity and of suitable type approved by Director General.
108. Every working chamber at an excavation or tunneling work where compressed air is used, the supply of such air shall be maintained not less than 0.3 cubic metre per minute per person working therein.
109. A reserve supply of compressed air shall be made available at all times for man-locks and medical locks used at a tunneling work.
110. The air supplied in a compressed air environment at a tunneling work shall be as far as practicable free from odour and other contaminants, namely, dust, fumes and other toxic substances.
111. The temperature in any working chamber at an excavation or tunneling work where building workers are employed shall not exceed 29 degree centigrade and the arrangement shall be maintained for keeping records in which the temperatures measured by dry bulb and wet bulb inside such working chamber once in every hour and to produce such records for inspection on demand.

112. Man-locks used at a tunneling work shall be of adequate strength, made of sound material and designed to withstand any pressure, internal or external, to which it may be subjected to in the normal use or in an emergency.
113. Doors of man-locks at an excavation or tunneling work shall be made of steel, airtight and devices shall be provided for sealing the doors when such locks are under pressure. The anchorage of a man-lock shall have adequate strength to withstand the pressure exerted by air on the man-lock. There shall be adequate room available for the workers for working in the man-locks. Where work is carried out in any compressed air tunnel, a Man-lock in accordance with the relevant national standards shall be used.
114. Where a man-lock is used at tunneling work, safety instructions in Hindi and in local language understood by majority of workers employed therein, shall be displayed at conspicuous places at such tunneling work. Except in an emergency, compression and decompression operations shall be carried out in a man-lock and in an emergency any material-lock may be used and a record shall be kept in writing for inspection on demand.
115. Material lock shall be used with the permission of the Director General for compression and decompression where it is impracticable to install both the man-lock and the material-lock at tunneling work. The man-lock at tunneling work shall not be used for any purpose other than compression or de-compression of workers. No decanting of workers at tunneling work shall be carried out without prior approval of the Director General except in an emergency.
116. In case a worker collapses or is taken ill during his decompression in a man-lock, the lock attendant of such man-lock shall raises the pressure in such manner until such pressure is equal to the maximum pressure which that worker was exposed to in the working chamber prior to such decompression and such lock attendant shall immediately report the matter relating to such collapse to the medical lock attendant and medical officer on duty at such tunneling work.
117. A worker who had previously received training with a trained worker to work in a compressed air environment at tunneling work shall be employed to work independently in such a compressed air environment.
118. Worker who had undergone three decompressions from a pressure exceeding one bar in a period of eight hours at tunneling work shall not be allowed to enter a compressed air environment except for the purpose of carrying out rescue work.
119. Worker employed in a compressed air environment for a period of eight hours in a day at tunneling work shall not be employed again in such environment unless he has spent not less than twelve consecutive hours of rest at atmospheric pressure.
120. No worker shall be engaged in a compressed air environment at a pressure which exceeds three bars at a tunneling work unless prior permission, in writing, has been obtained from the Director General.
121. No worker shall be employed in a compressed air environment for more than fourteen consecutive days in a month at tunneling work.
122. A register of employment of all workers employed in compressed air environment shall be maintained.
123. An identification badge shall be supplied to the worker employed in compressed air environment. The badge of a worker shall contain particulars of his name, location of the medical-lock allotted to him for work, the telephone number of the Medical Officer concerned for his treatment and the instructions in case of his illness of unknown and doubtful causes. Record of all identification badges supplied to the worker shall be kept in a register and every worker whose name appears in the register shall wear the badge supplied to him at all times during his duty hours at tunneling work.
124. Suitable warning signs shall be displayed in the compressed air environment for the prohibition of the following, namely:
    (i) use of alcoholic drinks;
    (ii) use and carrying of lighters, matches or other sources of ignition;
    (iii) smoking; and
    (iv) no entry to person who has consumed alcoholic drinks.

125. All workers employed in compressed air environment at tunneling work shall follow the instructions issued for their safety in the course of such employment.
126. A suitably constructed medical lock shall be maintained at tunneling work where workers are employed in a working chamber at a pressure exceeding one bar.
127. Where more than one hundred workers are employed in a compressed air working environment exceeding one bar at tunneling work, one medical-lock shall be provided for every one hundred workers or part thereof and such medical lock shall be situated as near as possible to the main-lock used at such tunneling work.
128. Protecting the vehicles Adequate and well-anchored stop blocks shall be provided on the surface to prevent vehicles being driven into the excavation while tipping a particular hazard when reversing. The blocks shall be placed at a sufficient distance away from the edges of the excavation to avoid the danger of it breaking away under the weight of the vehicles.
129. If the depth of the excavation is more than 1.5 meter, there are safe means of access and egress, such as a properly secured ladder.
130. There shall be adequate lighting around the area of an excavation, particularly at the access points and openings in barriers.
131. Necessary precautions shall be taken against hazards involving insects, snakes, poisonous plants / herbs etc.
132. The materials required to work in progress only shall be kept inside the tunnel.
133. The tunnel passage shall always be kept clear to enable the workers to get out of the tunnel quickly in case there is any collapse or any other mishap inside the tunnel.
134. Flammable liquids shall not be stored inside the tunnel.
135. All sources of ignition shall be prohibited in areas where flammable liquids are temporarily stored, handled and processed. Receptacles containing flammable liquids shall be stacked in such a manner as to permit free passage of air between them.
136. All spills of flammable liquids shall be cleared up immediately. Containers of flammable liquid shall be tightly capped.
137. All combustible materials like rubbish shall be continuously removed from such areas where flammable liquids are stored, handled and processed.
138. Fire extinguishers and fire-buckets shall be provided and properly maintained.
139. Communication system like Walkie-talkie shall be provided between all controls locations inside tunnel and portal of the tunnels.
140. Warning signals like, battery operated bells shall be placed outside the tunnel and the position of the switch shall be shifted with the progress of the tunneling work. The position of the operating switch although temporary shall be so chosen as to ensure proper accessibility and easy identification.
141. Red and green lights of adequate size and brightness shall be provided at suitable intervals on straight lengths and curves, cross over points etc, to regulate the construction traffic.
142. Usage of Earth leakage circuit breakers shall be encouraged for distribution of power supply from the panels for foolproof safety of the personnel.
143. A passageway not less than 60 cm wide shall be maintained in front of switchboards.
144. Rubber mats shall be provided & maintained in front and in back of the switch-boards.
145. The space in front or back of a switchboard shall not be used as a change room, locker or storage room.
146. All electric wires carrying voltage 440 volts and above installed underground shall be in the form of insulated lead covered cables, armoured effectively against abrasion and effectively grounded.
147. All electrical equipment in use shall bear the essential details of voltage, amperage and circuit diagrams etc.
148. All places where electrical apparatus is installed shall be adequately ventilated in order to ensure proper cooling of the apparatus and dilution of flammable gases.
149. All parts of the electrical installations used in the tunnel shall:
    (i) be so constructed, installed and maintained as to prevent danger of fire and electric shock;

(ii) be of adequate mechanical strength to withstand working conditions underground; (iii) be earthed/ grounded properly from at least two distinct earthing sources;
(iv) be not liable to be damaged by water, dust or electrical, thermal or chemical action, to which they may be subjected;
(v) be efficiently insulated or have all bare live parts enclosed or otherwise protected; and
(vi) be installed at such a location that dumpers or wagons do not come in contract with the same.

150. The voltage in the ranges of 110 Volts or even lesser voltages shall be used for lighting arrangements & operating portable hand tools inside the tunnel.
151. Adequate lighting shall be provided at the face and at any other point where work is in progress, at equipment installations, such as pumps, fans and transformers. A minimum of 50 lux shall be provided at tunnel and shaft headings during drilling, mucking and scaling. When mucking is done by tipping wagons running on trolley tracks a minimum of 30 lux shall be provided for efficient and safe working. The lighting in general in any area inside the tunnel or outside an approach road etc. shall not be less than 10 lux.
152. Emergency lights (battery operated) shall be used at the working faces and made available at intervals along the tunnel to help escape of workmen in case of accidents. All supervisors and gang-mates shall wear cap lamps or carry hand torches.
153. Any obstruction, such as drill carriages, other jumbos and drilling and mucking zones in the tunnel shall be well lighted.
154. Most tunnels are wet or damp providing a perfect ground for short circuits. Electrocutions in tunnels are too frequent. Steel forms and drill carriages shall therefore be properly grounded. The switches shall be located on a high ground and these shall be properly grounded.
155. All electrical apparatus including portable tools shall be connected only to an electrical supply system, which shall have proper earthing and grounding.
156. It shall be ensured that Telephone lines are laid on the opposite side of the electric lines side of the tunnel. No blasting line shall preferably be laid within 3 m of the light and power lines; its distance from a telephone line being immaterial so long as insulation can be ensured.
157. Underground-Hand lamps shall be:
(i) Of low voltage lamps (55 v to 110v) with cover.
(ii) Equipped with strong cover of glass or other transparent material, (iii) Dust and water proof,
(iv) Equipped with a guard over the cover and,
(v) The exterior of all lamp sockets shall be non-metallic.
158. On the occurrence of a fire caused by any electrical apparatus, the supply of electricity shall be cut off from such apparatus or installation as soon as practicable.
159. Mechanical ventilation shall be provided where necessary to force the air in or exhaust the air out from the working face to the portal through a pipe.
160. If the structure of the rock is weak, poor or structurally defective it shall be adequately supported by providing either bolts or timber or steel supports with proper lagging and back filling and or by shot crating.
161. If the tunnel excavation is in loose strata, the strata shall be supported by well-designed members either of wood or steel immediately before further excavation is undertaken. Shot Crete shall be sprayed immediately after the scaling to avoid further loosening of soil.
162. For tunneling in soft strata, the provision of IS: 5778-Part III (Code of practice for construction of tunnels) shall be followed in respect of quick supporting of such strata.
163. The loading zones shall be well lighted and workmen shall be kept away from the vicinity of the vehicles being loaded to prevent injury due to rock falling off the car.
164. Loading of muck into either cars or dumpers shall be done evenly and the muck shall not be piled dangerously high above the sides.
165. A signal man shall be deployed for a continuous vigilance to caution the people coming close to the swing of the loaders.

166. As far as practicable no other person shall be allowed at mucking area other than a operator, his helper and signal man.
167. The trolley tracks shall be properly laid with points, crossings and junctions and adequately maintained.
168. At each end of the track suitable blocks or buffers shall be provided.
169. A shovel shall never be left unattended with engine running and brakes not set. When it is necessary to park it on a sloping ground, it shall be securely blocked. The operator while leaving the machine shall remove ignition key and keep with him or hand it over to some responsible person so that the machine cannot be operated by unauthorized person.
170. Vehicles carrying pipe, rail and timber shall be properly loaded for safe passage through tunnel. The load shall be kept within the side limits for the vehicle.
171. No one shall be allowed to ride on front steps of loaders, dumpers etc.

## CHAPTER 49: SAFETY WHILE WORKING IN GASSY TUNNELS

While working in tunnels employees may come in contact with poisonous gases like methane. Tunnels are classified as Gassy, Potential Gassy or Non gassy. Sandstone can have small isolated pockets of methane gas so tunnels can be potential gassy.

### A. Potentially Gassy Operations:

Potentially gassy operations occur under either of the following circumstances:

1. When air monitoring shows, for more than a 24-hour period, 10 percent or more of the lower explosive limit (LEL) for methane or other flammable gases measured at 12 inches, 10.25 inch from the roof, face, floor, or walls in any underground work area; or
2. When the geological formation or history of the area shows that 10 percent or more of the LEL for methane or other flammable gases is likely to be encountered in the underground operation.

### B. Gassy Operations:

Gassy operations occur under the following conditions:

1. When air monitoring shows, for 3 consecutive days, 10 percent or more of the LEL for methane or other flammable gases measured at 12 inches, 10.25 inch from the roof, face, floor, or walls in any underground work area; or
2. When methane or other flammable gases mandating from the strata have ignited, indicating the presence of such gases; or
3. When the underground operation is connected to a currently gassy underground work area and is subject to a continuous course of air containing a flammable gas concentration.

When a gassy operation exists, additional safety precautions are required. These include using more stringent ventilation requirements; using diesel equipment only if it is approved for use in gassy operations; posting each entrance with warning signs, prohibiting smoking and personal sources of ignition, maintaining a fire watch when hot work is performed, and suspending all operations in the affected area until all special requirements are met or the operation is declassified. Additional air monitoring is also required during gassy conditions.

### C. Air Monitoring:

It is required to assign a competent person to perform all air monitoring required to determine proper ventilation and quantitative measurements of potentially hazardous gases. In instances where monitoring of airborne contaminants is required to be conducted "as often as necessary," this individual is responsible for determining which substances to monitor and how frequently, taking into consideration factors such as jobsite location, geology, history, work practices, and conditions.

The atmosphere in all underground areas shall be tested quantitatively for carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other toxic gases, dusts, vapors, mists, and fumes as often as necessary to ensure that prescribed limits are met. Quantitative tests for methane shall also be performed in order to determine whether an operation is gassy or potentially gassy. A record of all air quality tests (including location, date, time, substances, and amount monitored) is to be kept aboveground at the worksite and shall be made available upon request.

a) Oxygen

Testing is to be performed as often as necessary to assure that the atmosphere at normal atmospheric pressure contains at least 19.5 percent oxygen, but not more than 22 percent.

b) Hydrogen Sulfide

When air monitoring indicates the presence of 5 parts per million (ppm) or more of hydrogen sulfide, testing is to be conducted in the affected area at the beginning and midpoint of each shift until the concentration of hydrogen sulfide has been less than 5 ppm for 3 consecutive days. Continuous monitoring shall be performed when hydrogen sulfide is present above 10 ppm. Employees must be notified when the concentration of hydrogen sulfide is above 10 ppm. At concentrations of 20 ppm, an alarm (visual and aural) must signal to indicate that additional measures might be required (e.g., respirators, increased ventilation, evacuation) to maintain the proper exposure levels.

**D. Other Precautions:**

When the competent person determines that there are contaminants present that are dangerous to life, the employer must post notices of the condition at all entrances to underground work areas and must ensure that the necessary precautions are taken. In cases were 5 percent or more of the LEL for these gases is present, steps must be taken to increase ventilation air volume to reduce the concentration to less than 5 percent of the LEL (except when operating under gassy/potentially gassy requirements). When 10 percent or more of the LEL for methane or other flammable gases is detected where welding, cutting, or other 'hot' work is being performed, work shall be suspended until the concentration is reduced to less than 10 percent of the LEL. Where there is a concentration of 20 percent or more LEL, all employees shall be immediately withdrawn to a safe location aboveground, except those necessary to eliminate the hazard, and electrical power, except for acceptable pumping and ventilating equipment, shall be cut off to the endangered area until the concentration of the gas is less than 20 percent of the LEL. Potentially gassy and gassy operations require additional air monitoring. These include testing for oxygen in the affected work areas; using flammable gas monitoring equipment (continuous automatic when using rapid excavation machines; manual as needed to monitor prescribed limits); performing local gas tests prior to doing, and continuously during, any hot work; testing continuously for flammable gas when employees are working underground using drill and blast methods and prior to reentry after blasting.

**a) Ventilation:**

There are a number of requirements for ventilation in underground construction activities. In general, fresh air shall be supplied to all underground work areas in sufficient amounts to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases. A minimum of 200 cubic feet of fresh air per minute is to be supplied for each employee underground. Mechanical ventilation, with reversible airflow, is to be provided in all of these work areas, except where natural ventilation is demonstrably sufficient. Where blasting or drilling is performed or other types of work operations that may cause harmful amounts of dust, fumes, vapors, etc., the velocity of airflow must be at least 30 feet per minute. For gassy or potentially gassy operations, ventilation systems must meet additional requirements. Ventilation systems used during gassy operations also must have controls located aboveground for reversing airflow.

**b) Fire Prevention and Control:**

In addition to "Fire Protection and Prevention", open flames and fires are prohibited in all underground construction activities, except for hot work operations. Post signs prohibiting smoking and open flames where these hazards exist. Various work practices are also identified as preventive measures. For example, there are limitations on the piping of diesel fuel from the surface to an underground location. Also, the pipe or hose system used to transfer fuel from the surface to the storage tank must remain empty except when transferring the fuel. Gasoline is not to be used, stored, or carried underground. Gasses such as acetylene, liquefied petroleum, and methyl acetylene propadiene (stabilized) may be used underground only for hot work operations. Leaks and spills of flammable or combustible fluids must be cleaned up immediately. Work also requires fire prevention measures regarding fire-resistant barriers, fire-resistant

hydraulic fluids, the location and storage of combustible materials near openings or access to underground operations, electrical installations underground, lighting fixtures, fire extinguishers, etc.

**c) Hot Work:**

During hot work operations such as welding, noncombustible barriers must be installed below work being performed in or over a shaft or raise. As mentioned earlier, during these operations, only the amount of fuel gas and oxygen cylinders necessary to perform welding, cutting or other hot work over the next 24-hour period shall be kept underground. When work is completed, fuel gas and oxygen cylinders shall be removed.

**d) Emergencies:**

At work sites where 25 or more employees work underground at one time, employers are required to provide rescue teams or rescue services that include at least two 5-person teams (one on the jobsite or within one-half hour travel time and one within 2 hours travel time). Where there are fewer than 25 employees underground at one time, the employer shall provide or make available in advance one 5-person rescue team on site or within one-half hour travel time. Rescue team members have to be qualified in rescue procedures and in the use of firefighting equipment and breathing apparatus. The employer shall ensure that rescue teams are familiar with the jobsite conditions. Rescue team members are required to practice donning and using self-contained breathing apparatus on a monthly basis for jobsites where flammable or noxious gases are encountered or anticipated in hazardous quantities. As part of emergency procedures, the employer shall provide self-rescuers to be immediately available to all employees at underground work stations who might be trapped by smoke or gas. The selection, use, and care of respirators shall be in accordance with Mining standards. A "designated," or authorized, person shall be responsible for securing immediate aid for workers and for keeping an accurate count of employees underground. A portable hand or cap lamp, shall be provided to all underground workers in their work areas to provide adequate light for escape during emergency.

## CHAPTER 50: CONTROL OF DUST, SILICA AND NOXIOUS GASES IN UNDERGROUND WORKS

1. In every work place where persons are required to work in a confined place, adequate ventilation by the circulation of fresh air shall be provided and no person shall be allowed to enter any place where there is reason to apprehend that the atmosphere is poisonous or asphyxiating unless the person wears a suitable breathing apparatus and is equipped with life line held by a person stationed for the purpose in safe place.
2. When workers are employed in sewers and manholes which are in use, it shall be ensured that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manholes and manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accidents to the worker.
3. There shall be provided with sufficient and appropriate rescue apparatus including suitable breathing apparatus, suitable safety belts of sound material and ropes of adequate length and strength.
4. All such apparatus shall be placed in suitable position and they shall be readily available. They shall be in charge of a competent person conversant with their use and he shall be available at all time while any person is working in the confined place. All such equipment shall be properly maintained, tested and examined at intervals of not more than one month.
5. Effective measures shall be taken by providing suitable means to control the concentration of dust, gases and fume in the workplace within the permissible limit so that they may not cause injury to or pose health hazard to the worker.
6. When an exhaust appliance is necessary to prevent the accumulation of dust, fume and gases, it shall be applied as near as possible to the point of origin of the dust, fume or gas and such point shall be enclosed as far as possible.
7. Stationary internal combustion engine shall not be operated within the factory building or underground work unless the exhaust is conducted into the open air.

## CHAPTER 51: SAFETY IN PILING

1. Piling activity is associated with fall of operators due to openings. Fencing shall be provided around the working area to prevent on-lookers from trespassing into the construction sites.
2. Particular attention shall be given in case live electrical cables pass underground, which may interfere within the depth of foundation.
3. Every crane driver or hoisting appliance operator shall be competent to the satisfaction of the engineer In-charge and no person under the age of 21 years shall be in-charge of any hoisting machine including any scaffolding winch, or give signals to operator.
4. Nobody shall ever stand under a hammer and power driven pile drivers or extractors shall, have adequate controls, efficient brakes and suitable stops for the hammer.
5. A suitable cabin shall be provided for the driver wherever possible.
6. Any helmet or crown shall be of good design and construction, of sound and suitable material and free from patent defect. They shall be examined before any period of work or shift commences.
7. Frames and headers shall be examined for loose bolts and all hoses and connections shall be in good condition.
8. The end of a hose shall be tied to prevent it from "whipping" if a connection fails.
9. All parts of any structure shall be regularly and frequently examined and maintained in good condition.
10. If a mobile vehicle is used to support boring equipment it shall be stabilized.
11. Piling Rig (Pile Drivers) shall not be erected in dangerous proximity to electric conductors. If two pile drivers are erected at one place these shall be separated by a distance at least equal to the longest leg in either rig.
12. The frame of any rig shall be structurally safe for all anticipated dead, live or wind loads. Whenever there is any doubt about the structural strength, suitable test shall be carried out and the results of the test recorded.
13. No pile-driving equipment shall be taken into use until it is inspected and found to be safe.
14. Pile drivers shall be firmly supported on heavy timber sills, concrete beds or other secure foundation.
15. If necessary to prevent danger, pile drivers shall be adequately guyed.
16. When the rig is not in use, extra precautionary measures for stability, such as securing them with minimum four guys, shall be adopted to prevent any accidents due to wind, storm, gales and earthquake.
17. Access to working platforms and the top pulley shall be provided by ladders and the work-platforms shall be provided with guardrails. In tall driven piling rigs or rigs of similar nature where a ladder is necessary for regular use, the ladder shall be securely fastened and extended for the full height of the rig.
18. The ladder shall also be maintained in good condition at all times.
19. Exposed gears, fly wheels, etc. shall be fully enclosed.
20. Boilers, hoisting drums and brakes shall be kept in good condition and sheltered from weather, wherever possible.
21. Pile driving equipment in use shall be inspected by a competent engineer at regular intervals not exceeding three months. Also a register shall be maintained at the site of work for recording the results of such inspections.
22. Pile lines and pulley blocks shall be inspected by the foreman before the beginning of each shift, for any excess wear or any other defect.
23. Defective parts of pile drivers, such as sheaves, mechanism slings and hose shall be repaired by only competent person and duly inspected by Plant & Machinery Engineer and the results recorded in the register.
24. No Air Equipment shall be repaired while it is in operation or under pressure.
25. Hoisting ropes on pile drivers shall be of Independent Wire Rope Core (IWRC) type.
26. All bolts and nuts, which are likely to get loosened due to vibration during pile driving shall be checked regularly and tightened.

27. Airlines shall be controlled by easily accessible shut-off valves. These lines shall consist of armoured hose or its equivalent.
28. The hose of air hammers shall be securely lashed to the hammer so as to prevent it from whipping if a connection breaks.
29. Couplings of hoses shall be additionally secured by clamps or ropes or chains.
30. When not in use, the hammer shall be in dropped position and shall be held in place by a clear, timber or any other suitable means.
31. Hoisting Appliances used for handling piles etc. shall be marked with the safe working load and they shall not be loaded beyond 'the safe working load except for the purpose of testing'.
32. Motor gearing, transmission, electrical wiring and other dangerous parts of hoisting appliances shall be provided with efficient safe guards.
33. Hoisting appliances shall be provided with such means as will reduce, the minimum, the risk of accidental descent of the load and adequate precautions shall be taken to reduce to the minimum, the risk of any part of suspended load becoming accidentally displaced.
34. Sheaves on pile drivers shall be guarded so that workers may not be drawn into them. When loads have to be inclined:
    (i) They shall be adequately counter-balances; and
    (ii) The tilting device shall be secured against slipping.
35. Adequate precautions shall be taken to prevent a pile driver from overturning if a wheel breaks.
36. Adequate precautions shall be taken by providing stirrups or by other effective means, to prevent the rope from coming out of the top pulley or wheel.
37. Adequate precautions shall be taken to prevent the hammer from missing the pile.
38. If necessary to prevent danger, long piles and heavy sheet piling shall be secured against falling.
39. Where electricity is used as power for piling rig, only armoured cable conforming to the relevant Indian Standard shall be used and the cable shall be thoroughly waterproofed.
40. The pin of the D-Shackle, which connects Bailer / Chisel and winch rope is more prone to wear & tea. Frequent check is essential. Further, as the pin is liable to get removed from the shackle, it is preferable to use a shackle which has a provision to lock the pin.
41. Tripod Base Support of the Tripod Leg shall be suitably designed and it shall have adequate length and width. Base of the tripod legs shall be anchored in the ground at both ends. Fastening arrangement of Tripod Leg with Base Support shall preferably have HT bolt and nut with split pin.
42. Splice Joint is not recommended in the Rear (main) Leg of the Tripod. If joint is unavoidable, the position of the splice joints shall be at the lowest point so that the vibration is minimized.
43. Vibration shall be maximum at the centre. Frequent inspection shall be ensured.
44. Winch Rotating / Moving parts of winch shall be guarded. Winch shall be tested at least once in a year by Competent Authority.
45. Friction Brake & Mechanical Brake (Ratchet and Paul) shall be kept intact and inspected at least once in a week. Wire Rope shall be free from defects.
46. Splicing / Clamping of Wire Rope shall be done as per standard.
47. Pulleys, D-shackles and Bulldog clamps shall be in order. Main Pulley and it's Pin are prone to wear & tear. Frequent check is essential.
48. Similarly, the pin of the D-Shackle, which connects Bailer / Chisel and winch rope is also more prone to wear & tear. Frequent check is essential.
49. General Distance between the piling rigs shall be not less than the length of longest leg of the tripods. Earth slush shall be removed and passage shall be kept clear.
50. Exposed reinforcement heads shall be properly covered / barricaded.
51. Hard barricade shall be provided around bentonite pit to prevent fall of persons inside.
52. Workmen shall not wear loose clothes as they may entangle with the rotating and moving parts of the winch.
53. Pile boreholes shall be kept covered or barricaded.

## CHAPTER 52: SAFETY IN STRUCTURAL STEEL WORK AND FORMWORK

1. Structural steel erection shall be commenced only when the concrete in the footings, piers and walls or the mortar in the masonry piers and walls has attained either 75 percent of the intended minimum compressive design strength or sufficient strength to support the loads imposed during steel erection.
2. The foundation of each column shall be capable of withstanding both vertical load and also the additional horizontal thrust, which is developed as soon as temporary supports / props are removed.
3. Pre-cast frame columns are usually inserted into sockets cast into the foundation blocks and consequently shall be held temporarily in place after alignment. Wedges and props shall be used for this purpose until the column is made secure by grouting.
4. Foundation bolts are designed for the loads experienced by completed structure and are not always suitable for the more severe conditions encountered during early stages of construction. It is during this phase that excess loads if applied to them, will give rise to the danger of collapse unless adequate temporary bracing is provided in the form of props or guys. As an alternative to the preferred method of bolts cast into foundation blocks, the use of rag bolts in open pockets is sometimes advocated to avoid the need for accurate setting out; this system shall be discouraged.
5. Adequate numbers of steel plate packing pieces shall be provided for use in leveling prior to grouting operations. Once the frame is erected, lined and leveled, it is essential that holding foundation bolts are maintained tight.
6. The trained worker under the direct supervision of a person, responsible for structural frame and formwork, shall be employed for erection of such structural frame or formwork, dismantling of building and structure and performance of and engineering work, formwork, false work and shoring work.
7. Adequate measures shall be taken to guard against hazards arising from any temporary state of weakness or unsuitability of a structure.
8. Formwork and false work shall be so designed, constructed and maintained that such formwork and false work are able to support the load that may be imposed on them.
9. Such formwork shall be so erected that working platform, means of access, bracings, means of handling and stabilizing could easily be fixed with such formwork.
10. The safety of the worker employed for the erection or dismantling of steel structure and pre-fabricated structure shall be ensured from danger by using appropriate means such as ladders, gangways or fixed platforms, buckets, boatswains chair or other appropriate means suspended from lifting appliances, safety harness, life lines, catch nets or catch platforms, power-operated mobile working platforms etc.
11. The work of erection or dismantling of buildings or structures or formwork or false work or shoring or any other civil engineering work shall be carried out by trained building workers under the supervision of a person responsible for such work.
12. Steel or prefabricated structures shall be so designed and made that such structures can be safely transported or erected and weight of each unit of such structures shall be clearly marked on such unit.
13. The design of each such part shall maintains stability of each part of the structures referred to in clauses above when erected, and to prevent danger, the design shall explicitly take into account –
    (i) the relevant conditions and methods of attachment in the operations of stripping, transport, storing and temporary support during erection of such parts;
    (ii) safeguards, such as provision of railings with working platforms, and for mounting such railings and platforms easily on the structural steel or prefabricated parts.
14. The hooks and other devices built in or provided on the structural steel or prefabricated parts that are required for lifting and transporting such parts shall be so shaped, dimensioned and positioned to withstand the stresses to which such hooks or other devices are subjected.
15. Prefabricated parts made of concrete shall not stripped or erected before such concrete has set and hardened sufficiently to the extent provided for in the plans, and such parts are examined by the responsible person for any sign of damage before their use.
16. Store-places shall be so constructed that –
    (i) there shall be no risk of structural steel of prefabricated parts falling or overturning;

(ii) storage conditions shall generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions; and
(iii) racks shall be set on firm ground and designed so that units cannot move accidentally in such store-places.

17. Structural steel or pre-fabricated parts shall not be subjected to stresses prejudicial to their stability while they are stored or transported or raised or set down.
18. Tongs, clamps and other appliances for lifting structural steel and prefabricated part shall be in such shape and dimensions as to ensure a secure grip without damaging such parts and marked with the maximum permissible load in the most unfavorable lifting conditions.
19. Structural steel or pre-fabricated parts shall be lifted by such methods and appliances that prevent them from spinning accidentally.
20. Structural steel or pre-fabricated parts shall be provided with railings and working platforms before raising such parts to prevent any danger of falling of workers, materials or articles at the time of any work with such parts.
21. All reasonably practical measures shall be taken to avoid injury to the workers, building structure or equipment while structural steel or pre-fabricated parts are handled or stored or transported or raised or lowered.
22. Structures shall not be worked on during violent storms or high winds or any other such hazardous situation.
23. The risk of falling to which workers, moving on high or sloping girders, may be exposed is limited by all means of adequate collective protection or by the use of a safety harness which shall be well secured to a sufficiently strong support.
24. Structural steel parts, which are to be erected at a great height, shall, as far as practicable, be assembled on the ground.
25. When structural steel or pre-fabricated parts are being erected, a sufficiently extended area underneath the workplace shall be barricaded or guarded.
26. Steel trusses, which are being erected, shall be adequately shored, braced or guyed until they are permanently secured in position.
27. Structural members shall not be forced into place by the hoisting machine while any worker is in such a position that he is likely to be injured by such operation.
28. All formwork shall be properly designed keeping in view the safety of workers, buildings or structures.
29. A responsible person for structural frame and formwork shall:
    (i) inspect and examines the material, timber, structural steel and scaffolding for its strength and suitability before being taken into use;
    (ii) lays down procedures to cover all stages of such structural frame and formwork;
    (iii) supervises such structural frame and formwork;
    (iv) take all necessary steps or measures to correct any situation with a view to prevent accident or dangerous occurrence during performances of such structural frame and formwork.
30. When shoring is removed, sufficient props shall be left in place of such shoring to prevent any possible hazard.
31. De-shoring shall be adequately braced or tied together with support to prevent any hazard.
32. Cranes being used in steel erection activities shall be visually inspected every day prior to the commencement of work. The inspection shall include the following:
    (i) All control mechanisms for adjustments;
    (ii) Control and drive mechanism for excessive wear of components and contamination by lubricants, water or other foreign matter.
    (iii) Safety devices including but not limited to boom angle indicators, boom stops, boom kick out devices and over hoist limit switch, load moment indicators;
    (iv) Air, hydraulic and other pressurized lines for deterioration or leakage;
    (v) Hydraulic system for proper fluid level;
    (vi) Hooks and latches for deformation, chemical damage, cracks or wear;

(vii) Wire rope revving for uniformity;
(viii) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt or moisture accumulation;
(ix) Tires for proper inflation and condition; and
(x) Ground conditions around the hoisting equipment for proper support including ground settling under and around outriggers, ground water accumulation, or similar conditions.

## CHAPTER 53: SAFETY IN CONCRETING WORKS

1. All construction with the use of concrete or reinforced concrete shall be based on plans as-
   (i) include specification of steel and concrete and other materials to be used in such construction;
   (ii) giving technical details regarding methods for safe placing and handing of such materials;
   (iii) indicate the type, quality and arrangement of each part of a structure of such construction; and
   (iv) explaining the sequence of steps to be taken for completion of such construction.
2. Formwork and shores used for concrete work shall be structurally safe and properly braced or tied together so as to maintain position and shape of formwork or shores.
3. Formwork structure used for concrete work shall have sufficient catwalks and other secure access for inspection of such structure if such structure is in two or more tiers.
4. A worker handling cement or concrete shall:
   (i) wear close-fitting clothing, gloves, helmet or hardhat, safety goggles, proper footwear and respirator or mask to protect himself from danger in such handling;
   (ii) keep as much of his body covered as is required to protect himself from danger in such handling;
   (iii) take all necessary precautions to keep cement and concrete away from his skin in such handling.
5. Lime pits shall be fenced or enclosed, filled and emptied by such devices, which do not require workers to go into the pit.
6. Moving parts of the elevators, hoists, screens, bunkers, chutes, grouting equipment used for concrete work and of other equipment used for storing, transport and other handling ingredients of concrete shall be securely fenced to avoid contact of workers with such moving parts.
7. Screw conveyors used for cement, lime and other dusty materials shall be completely enclosed.
8. Concrete buckets used with cranes or aerial cableways shall be free from projections from which accumulations of concrete could fall.
9. Movements of concrete buckets shall be governed by signals necessary to avoid any danger by such movements.
10. A scaffolding carrying a pipe for pumped concrete shall be strong enough to support such pipe at a time when such pipe is filled with concrete or water or any other liquid and carry the combined load of the all the workers who may be on such scaffold at such time, safely.
11. Every pipe for carrying pumped concrete shall be:
    (i) securely anchored at its end point and at each curve on it;
    (ii) provided near the top of such pipe with an air release valve;
    (iii) securely attached to a pump nozzle by a bolted collar or other adequate means.
    (iv) This type of equipment shall be operated only by persons who have been trained and who have knowledge of the risks involved and of precautionary measures.
    (v) They shall never station themselves in potentially dangerous places; the equipment must be of sound design and construction;
    (vi) The number of bends in any length of piping or ducting shall be kept to a minimum and no sharp elbows or bends shall be allowed. Their presence leads to blockages and is in any case inefficient;
    (vii) Pipes or ducting shall be kept clean internally and scoured to remove hard deposits
    (viii) It is advised that a weak solution of concrete shall be transmitted through piping before the normal consistency is delivered. This is suggested so that there will be less frictional resistance;

care shall be taken not to transmit through the pipes excessive amounts of concrete otherwise blockages may occur; great care must be taken when cleaning pipes or removing blockages. Many serious accidents have occurred when material has been forcibly ejected. Pressure shall be cut off during these operations. Where compressed air is used there shall be an expansion chamber or other device to prevent violent discharge at the outlet.

12. The operation of concrete pumps shall be governed by standard signals.
13. Workers employed around a concrete pump shall wear safety goggles.
14. The concrete mixture shall not contain any material, which may unduly affect the setting of such concrete, weaken such concrete or corrode steel used with such concrete.
15. When dry ingredients of concrete are being mixed in confined spaces such as silos, the dust shall be exhausted at the time of such mixing and in case the dust cannot be exhausted the workers shall wear respirator at the time of such mixing.
16. When concrete is being tipped from buckets, workers shall be kept out of the range of any kickbacks of such buckets.
17. Loads shall not be dumped or placed on settling concrete.
18. All parts of a concrete panel or concrete slab shall be hoisted uniformly.
19. Concrete panels shall be adequately braced in their final positions and such bracings shall remain in such positions until such panels are adequately supported by other parts of the construction for which such panels are used.
20. Temporary bracing of concreter panels shall be securely fastened to prevent any part of such panels from falling when such panels are being moved.
21. Workers shall not stand directly over jacking equipment while stressing of concrete girders and beams is being done.
22. A pre-stressed concrete unit shall not be handled except at points on such unit and by the devices specified for such work by the manufacture of such devices.
23. During transport, pre-stressed concrete girders or concrete beams shall be kept upright by bracing or other effective means.
24. Anchor fittings for pre tensioned strands of pre-stressed concrete girders or concrete beams shall be kept in a safe condition in accordance with the instruction of manufacturer of such anchor fittings.
25. Workers shall not stand behind jacks or in line with tensioning elements and jacking equipment during tensioning operations of pre-stressed concrete girders or concrete beams.
26. Workers shall not cut wires of pre-stressed concrete girders or concrete beams under tension before such concrete used of such girder or beams is sufficiently hardened.
27. A worker, who is in good physical condition, shall operate vibrators used in concreting work.
28. All practical measures shall be taken to reduce the amount of vibration transmitted to the operators working in concreting work.
29. When electric vibrators are used in concreting work-
    (i) such vibrators shall be earthed;
    (ii) the leads of such vibrators shall be heavily insulated; and
    (iii) the current shall be switched off when such vibrators are not in use.
30. A person responsible for a concreting work shall supervise the erection of the formwork, shores, braces and other supports used for such concreting work, makes a thorough inspection of every formwork to ensure that such formwork is safe and keep all records of inspections referred to above at the workplace and produce them for inspection upon the demand.
31. Any unsafe condition which is discovered during the inspection shall be remedied immediately.
32. Horizontal and diagonal bracings shall be provided in both longitudinal and transverse direction as may be necessary to provide structural stability to formwork used in concreting work and shores used in such concreting work shall be properly seated on top and bottom and secured in their places.
33. Where shores used in concreting work rest upon the ground, base plates shall be provided for keeping such shores firm and in level.

34. Where the floor to ceiling height of a concreting work exceeds 9 m or where the formwork deck used in such concreting work is supported by shores constructed in two or more tiers, or where the dead, live and impact loads on the formwork used in such concreting work exceed 700 kilogram per sq. metre, the structure of such formwork shall be designed by a professional engineer in the relevant field and the specifications and drawings of such formwork shall be kept at such construction site and produced on demand.
35. Where a professional engineer designs the structure of the formwork used in concreting work, such engineer shall be responsible for the supervision of construction and stability of such structure.
36. Stripping of formwork used in concreting work shall not commence until the concrete on such formwork is fully set, examined and certified to this effect by the responsible person and record of such examination and certification is maintained.
37. Stripped forms in concreting work shall be removed or stock piled promptly after stripping from all areas in which workers are required to work or pass.
38. Protruding nails, wire ties and other formwork accessories not required for subsequent concreting work shall be pulled, cut or otherwise made safe.
39. Re-shoring used in concreting work shall be provided to a slab or beam for its safe support after its stripping or where such slab or beam is subjected to superimposed loads due to construction above such slab or beam.
40. The provisions applicable to shoring in a concreting work shall also be applicable to re-shoring in such work.
41. Modern equipment has simplified the problem of providing adequate support for shuttering during the period that shuttering is in use, particularly where support is required under an extensive horizontal area. As well as traditional materials, use can be made of telescopic steel centres designed to carry loads over specified spans, and adjustable steel props.
42. The erection of shuttering and of its support is a job which must be supervised by persons who have the necessary knowledge and experience and undertaken by workers who also have an understanding of the work. It is necessary to take account not only of the static loading "but of the dynamic forces applied during pouring and other operations, which must be done carefully. Where vertical supports are used, no movements shall take place in their vicinity which could cause them to "be damaged or displaced and they shall have a firm footing.

## CHAPTER 54: SAFETY IN PAINTING WORKS

Overexposure to a substance means too much has been breathed in, swallowed or absorbed through the skin. The possible effects of overexposure to paint and the chemicals it contains vary according to the type of paint.

**A. Health problems caused by overexposure to paint materials:**

1. drowsiness;
2. dizziness/light headedness;
3. disorientation;
4. nausea/vomiting;
5. eye and throat irritation;
6. dermatitis;
7. general allergic response such as hives;
8. asthma-like wheezing with tightness in the chest;
9. heavy metal poisoning (lead, chromium, nickel and cadmium); or
10. Nerve, kidney or liver damage.

**B. Precautionary measures while painting:**

1. Any machinery/ equipment shall be cleaned only after getting the necessary clearance from the concerned department.
2. Standard colour code of machinery /pipe lines etc. shall never be changed without proper Permission of the concerned department.
3. A painter must always be provided with a Helper/ Asst. when painting at heights.
4. A supervisor must always be present at site whenever painting at heights is being done.
5. While painting at heights in addition to having safety belt, painter shall engage one hand in holding the paint brush and the other hand to catch support for him. Paint –box shall never be carried in the hand while painting at heights.
6. Before commencing painting of structure etc. near crane walkways, the crane operators in that area shall be informed if the painting job to be undertaken and red flags shall be displayed on both ends of the rail tracks.
7. Safety belts must always be worn when painting at heights. It is desirable to have safety nets tied below the area of work as additional protection in case of a fall.
8. While painting at heights, if any crane comes just under the spot, stop painting and just sit or stand there till the crane moves away.
9. Great care shall be taken to see that the crane bus-bars are not contacted either by the scaffoldings, slings or other hanging materials. Any job in the bus-bar area is to be done only after getting power shutdown.
10. While painting overheads, plain goggles shall be worn to prevent paint from falling in eyes.
11. Make sure the correct types of fire extinguishers are available at the work site.
12. No worker shall be employed below the age of 18 and women on the work of painting with products containing lead in any form. Whenever men are employed on the work of lead painting, the following precautions shall be taken:
    (i) No paint containing lead or lead products shall be used except in the form of paste or ready-made paint.
    (ii) Suitable face masks shall be supplied for use by them when paint is applied in the form of spray on a surface having lead paint dry rubbed and scrapped.
    (iii) Coveralls shall be supplied to the workmen and adequate facilities shall be provided to enable the working painters to wash after cessation of work. As an additional protective measure, use

BARRIER CREAMS on hands, face and neck. Check to make use the correct barrier cream for the chemicals being used.

**C. Dos and Don'ts before painting:**

1. Post "No Smoking" and "No Welding" signs.
2. Remove portable lamps and heaters from the area.
3. Make sure painting is done away from naked flames, sparks, non-explosion proof motors or any other source of ignition.
4. Check the ventilation system to make sure it is on and working correctly.
5. Electrically ground all spraying equipment.
6. Make sure approved respirator, eye goggles and any other protective equipment required for the job are worn.
7. DON'T Smoke.
8. DON'T take more paint out of the store room than use in one day.

## CHAPTER 55: SAFETY IN CONSTRUCTION OF DAMS

All safety measures mentioned in this manual is applicable for construction of dam. However, following points are to be considered.

1. Safe means of access to workplace.
2. Safe handling or use of explosives under the control of competent person.
3. Erection, installation, use and maintenance of transport equipment.
4. Erection, installation, use and maintenance of hoists, lifting appliances and lifting gear; testing and examination.
5. Providing adequate and suitable lighting of every workplace and approach thereto, of every place where raising or lowering operations with the use of hoists, lifting appliance or lifting gears are in progress and of all openings dangerous to building workers.
6. Precautions to prevent inhalation of dust, fumes, gases or vapours, secure and maintain adequate ventilation.
7. Measures to be taken during handling, stacking or unstacking of materials.
8. Safeguarding of machinery.
9. Safe handling and use of plant and tools and equipment operated by compressed air.
10. Precautions to be taken in case of fire.
11. Limits of weights to be lifted or moved by workers.
12. Safe transport of workers.
13. Steps to be taken to prevent danger to workers from live electric wires or apparatus.
14. Keeping of safety nets, safety sheets and safety belts.
15. Standards to be complied with regard to scaffolding, ladders and stairs, lifting appliances, ropes, chains and accessories, earth moving equipment, etc.
16. Precautions with respect to excavation, pile driving, reinforcement and concrete work, hot asphalt, welding and gas cutting, structural steel work and demolition operations.
17. Provision and maintenance of medical facilities for building workers.
18. Safety and health of workers working in any of the operations being carried on in a building or other construction work

## CHAPTER 56: SAFETY IN CONSTRUCTION OF COFFERDAMS AND CAISSONS

### A. Cofferdam:

It is a temporary structure used for river work, dam construction, and for foundation work for bridge piers. They may enclose quite considerable areas. The following safety measures shall be adopted in cofferdam.

1. It must be stable and constructed so as to resist and prevent the entry of water whether it is constructed on a river bed or on land.
2. The first precautionary measure is that it shall be constructed and maintained by skilled persons under the control of a competent engineer.
3. The method of construction of cofferdams and the materials which are used will depend on circumstances. Interlocked sheet steel piles, or steel or timber piles either of single or double construction is used.
4. Where double walls are erected the space between is puddle filled.
5. Bracing across the internal area may be necessary, particularly with single wall structures and in strong running rivers.
6. Before any water or material can be removed from the area bounded by the cofferdam the piles must be sunk below an impermeable layer to prevent entry of water.
7. If such a layer cannot be found at a convenient depth it may be necessary to sink further piles within the area to support a concrete base, the concrete being deposited in a suitable manner below the water surface.
8. Sheet piling shall be watertight even if it is deflected by earth or water pressure on one side.
9. Water may enter a cofferdam in two ways against which some precautions can be taken. The first is by entry between the sheets and the second by underflow.
10. There shall be regular inspections to ensure that conditions remain satisfactory.
11. Necessary precautions against water flooding in the cofferdams are to be taken & arrangement for evacuation shall be handy for safety of the employees.

### B. Caissons:

Caisson is used instead of cofferdams where the area of a foundation is small in relation to the depth of water at the site. They are retained in position, the caisson being later filled with concrete to form a foundation for a pier. "Box" type caissons are used where a firm bearing strata which requires no excavation is available. They may be of timber or reinforced concrete construction, with a bottom but no top and are sunk either by weighting or placing the permanent concreting in position. "Open" type caissons are circular or rectangular in plan made of steel or reinforced concrete with either single or double walls and are open at the top and "bottom. They have cutting edges at the bottom which are forced into the ground "by additional weighting at the top or "by the weight of concrete placed between walls as the earth material is removed from the inside. The depth or height of such a caisson can be increased as it sinks by joining additional sections at the top. When the caisson reaches bearing strata its lower part is filled with concrete. Much of the work of excavating and concrete placing can be done from above water level; when it is necessary to secure dry conditions for excavation a pneumatic caisson is required. In pneumatic caissons, the total loads on the structure can be very high and any failure would be disastrous.

### C. Safety precautions applicable to cofferdams and caissons:

1. They shall be of good construction, sound material, adequate strength and designed by qualified persons and constructed or placed in position by persons with the requisite knowledge and experience.
2. They shall be properly maintained, inspected at least once per day and thoroughly examined at least once per week, immediately after any explosives have been used which may have affected their strength and stability, and after any substantial damage.

3. If any damage is noted which would make it dangerous for people to work in them, they shall be prohibited from doing so until the damage has "been rectified.
4. As far as it is possible, means shall be available for people to reach places of safety in case of flooding.
5. Safe means of access to every place shall be provided where workers are employed.
6. Work relating to construction, positioning, modification, dismantling of cofferdams or caissons shall be carried out under the supervision of a responsible person and inspected by a responsible person at the specified intervals.
7. Work in compressed air in a cofferdam or caisson shall be carried out in accordance with the procedure laid down in the relevant national standards.
8. If the work in cofferdam or caisson is carried out in shifts, a record of the time spent by each worker in each such shift for carrying out the wok shall be maintained in a register with particulars or time taken for the compression of such worker.
9. At every work site or project in a cofferdam or caisson, where workers are employed to work in compressed air environment, a construction medical officer assisted by a nurse or trained first-aid attendant, shall be available at all times.
10. There shall be one standby reserve compressor to meet the emergency at every work site or project in a cofferdam or caisson.

## CHAPTER 57: SAFETY IN QUARRIES, GRAVEL PITS AND BORROWED AREAS

1. All quarries shall be fenced and signs for warning people of the danger of blasting of otherwise shall be prominently posted.
2. The rock face of the quarry shall be scaled frequently to maintain safe working conditions. Scalars shall wear hard hats and safety belts and be securely tied off while at work.
3. So far as practicable, a minimum distance of 3 meters shall be maintained between workmen unless two or more are required to accomplish the same task. Drillers and other workmen shall wear respirators if dry-air drilling methods are used.
4. Visitors shall not be allowed to enter quarries in operation unless accompanied by a project official or his designated representative.
5. There shall be no undercutting of banks at any time, and any overhanging banks occurring as a result of slides or caving shall be removed before beginning excavation operations beneath them. Extreme care shall be exercised in the use of trucks and other equipment on or near the rim of the gravel pit, or on terrace or beams.

## CHAPTER 58: SAFETY IN GROUTING, GUNITING& SHOTCRETING

Usually safety precautions that are taken for concreting in open shall be applicable for the concreting of tunnels, shafts and other underground works also. In addition, the following precautions shall be taken where the pump crete or pneumatic placers used:

1. The scaffolding supporting the pipe shall be designed to carry the pipe when filled with concrete plus 100 percent overload plus the estimated weight of the maximum number of workmen that may work on the pipes while the pump is operating. A factor of safety of 4 shall be used.
2. The pipeline shall be anchored at all curves and near the end. The toggle and flange connections shall be inspected before each placement to ensure tight joints.
3. Air-release valves shall be installed at high points to release entrapped air. The use of these valves will assist in preventing line plugging and in turn reduce accident possibilities.
4. Pipes and hose used to convey grout shall be of proper size and strength to safely withstand the maximum operating pressures. Pumps shall not be operated at pressures above their rated capacity.
5. Cleaning of pipeline shall be carefully done.
6. Adequate lighting and ventilation shall be provided for all galleries and shafts where grouting is in progress.

## CHAPTER 59: PREVENTION FROM DROWNING

1. When there is a risk of drowning, suitable rescue equipment shall be provided and kept in an efficient state for ready use.
2. Measures shall be taken to arrange for the prompt rescue of worker from the danger of drowning.
3. Where there is a special risk of fall from the edge of adjacent land or from a structure adjacent to or above the water or from floating stage on water, secure fencing shall be provided near the edge of such land, structure or floating stage, as the case may be, to prevent such fall, and such fencing may be removed or allowed to remain un-erected for the time and to the extent necessary for the access of workers to such work or the movement of material for such work.
4. Employees working over or near water, where the danger of drowning exists, shall be provided with approved life jacket or buoyant work vests.
5. Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy.
6. Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations.
7. At least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water.
8. Training is to be imparted regularly to all the employees for rendering CPR (Cardio Pulmonary Resuscitation) and appropriate use of life saving equipment.

## CHAPTER 60: SAFETY MEASURES AGAINST LANDSLIDE

Landslides occur due to heavy rainfall, steep slope, seismic activity and poor drainage. Landslides are also caused due to deforestation, soil erosion, unrestricted excavation, mining and quarrying operation. Following safety measures shall be considered while constructing building or other structures in a landslide prone area.

1. No construction shall be allowed in the existing landslide area, at steep mountain slopes, near the valley or at the foothills of the mountain.
2. Flat surfaces away from sudden slopes and areas at the top or along the ridges are suitable for any construction.
3. Regular maintenance of drainage system is essential.
4. Surface drainage system shall be kept away from steep slopes, loose soil and non-vegetated land.
5. Barriers can be erected to avoid minor landslide.
6. Trees and thick vegetation may be planted to prevent landslides. Vetiver grass is one of the best verities of grass to create vegetation which is available in north eastern part of the country.

## CHAPTER 61: SAFETY AGAINST EARTHQUAKES / GEOLOGICAL SURPRISES, FLOODING AND FLASH FLOODING

### A. Earthquake:

In the event of an earthquake, it is important not to create panic and deal effectively with the situation by taking or adopting following general precautions:

1. Secure easily toppled items so that they do not fall over.
2. Do not place heavy, pointed or hard objects on high shelves loosely in the workplace.
3. Make it a habit to keep flammable objects away from furnaces, fireplaces, and gas-run appliances.
4. Fire is the most destructive result of an earthquake. If an earthquake occurs at workplace, extinguish all sources of fire. Turn off the main gas valve, all electric lights and appliances, and locate emergency supplies. Disconnect all electrical appliances.
5. Put on shoes to protect your feet from broken glass, etc. and secure an escape.
6. Areas that have many pillars are free of heavy objects that may be apt to fall, and the areas beneath strong furniture, etc. are relatively safe.
7. In the case of a two-story building the second floor is often safer as the ground floor may be destroyed.
8. Wear a helmet or quilted hood that will protect the head. Place a cloth (preferably wet) across the nose and mouth to prevent smoke or dust inhalation.
9. Do not use elevators. Use only emergency stair case.
10. Watch out for glass, signs, or other falling objects.
11. Eventually, leave the work place and take refuge in a safe area.
12. Even though the first large shock has ceased, aftershocks may continue for a considerable time. Therefore, do not attempt to return to workplace right away. It is important to know what the actual situation is in order to avoid further disaster.
13. Protect yourself, drop to the floor, take cover under a sturdy desk or table and hold on to it so that it doesn't move away from you. Wait there until the shaking stops.
14. Stay away from glass windows, heavy furniture & anything that could fall, such as lighting fixtures or other similar items.
15. If you are on the upper floor of the building, don't jump from window or balcony.
16. Do not try & run out of a building, you may be hit by falling debris. Stay inside till the shaking stops & check if it is safe to go outside.
17. If you are outdoors, find a clear spot away from buildings, trees, electrical lines & narrow streets. Drop to the ground & stay there until the shaking stops.

18. If you are in a vehicle, pull over to a clear location, stop & stay there with your seatbelt fastened until the shaking stops. Avoid bridges, flyovers or ramps that might have been damaged by the earthquake.
19. Don't use your two-wheeler/car to drive around the area of damage.
20. Do not attempt to drive during or after a severe earthquake.
21. If in coastal area, move to higher ground and check tsunami warning. If you are in a hilly area be alert and move away from slopes in case of landslides and falling rocks.
22. Watch out for fallen power lines or broken gas lines and stay away from damaged areas.
23. Don't enter partially damaged buildings. Strong aftershocks can cause further damage to the buildings & weak structures may collapse. Anticipate aftershocks, if shaking lasts longer than usual.
24. Leave a message stating where you are going if you must evacuate your residence.
25. Evaluate damages & repair any deep cracks in ceiling, beam, column & foundation with the advice of an expert/structural engineer.

B. **Flood**

In the event of a flood, general precautions that need to be followed include:

1. Keep on hand a battery-operated flashlight while mining or tunneling operations.
2. Have a prior knowledge of the evacuation routes.
3. Do not attempt to cross a stream where water is above your knees. When in doubt, don't try it.
4. Do not try to drive over a flooded road. The water can be much deeper than it appears and you could be stranded or trapped.
5. Stay away from drains and ditches.
6. Do not enter into the flood water.
7. Do not eat fresh food that has come in contact with flood waters. Boil drinking water before using.
8. Immediately report to the maintenance staff regarding broken gas, electrical and water supply lines.
9. Do not handle electrical equipment in wet areas.
10. Submerged gas control valves, circuit breakers, and fuses pose explosion and fire hazards, and shall be replaced as the water subsides.
11. If your workplace has been flooded do not attempt to turn the power back on, have all wiring inspected by the maintenance staff.

## CHAPTER 62: SAFETY IN CONSTRUCTION, REPAIR AND MAINTENANCE OF STEEP ROOF

1. All practicable measures shall be provided to protect the workers against sliding when carrying out work on steep roofs.
2. Roofing brackets shall be constructed to fit the pitch of steep roof and such brackets shall be used to provide level working platform.
3. Roofing bracket shall be secured in its place by nailing pointed metal projections attached to the underside of such bracket and securely driven into a steep roof on which it is used or secured by a rope passed over the ridgepole and tie of such roof.
4. All crawling boards used for work on steep roofs shall be of adequate strength, made of sound material and of the type approved for the purpose of their use as per national standard.
5. Crawling boards shall be kept in good repairs and inspected by a responsible person before being taken into use.
6. Crawling boards shall be secured to a steep roof on which it is used by ridge hooks or other effective means.
7. A firmly fastened lifeline of adequate strength shall be strung beside each crawling board throughout its length while using such crawling boards.

## CHAPTER 63: SAFETY WHILE WORKING IN HILLY AREAS, RAINY AND FOGGY ENVIRONMENT

Additional hazards of rainy & foggy environment are introduced by: a) reduced daylight hours, rain/snow/fog/ice. The following measures shall be taken while working in rainy and foggy environment.

1. In the event of the near approach of lightning or thunderstorm all work shall cease immediately.
2. "Man at work" signboard shall be displayed or barricade tap shall be provided while working in rainy or foggy environment.
3. Hurricane lamp and signal man with red and green flag shall be provided at the working area.
4. Illumination levels reduce drastically during foggy conditions and if it is on hilly location the visibility during the day is also reduced. Particular attention shall be paid to lighting requirements for staircases, pedestrian walkways, access roads, loading areas, plant yards, car parks etc.
5. Car parks, access roads and pedestrian walkways shall be kept clear as practicable.
6. Check condition of tyres, especially for under inflation. Cold overnight temperatures result in lower tyre pressures at the beginning of a morning shift.
7. Consider suspension of operations during extreme periods of poor visibility.
8. Oils will be thicker during cold temperatures so allow the vehicle extra time to warm up before moving off to allow complete circulation of the oil through the engine/hydraulics.
9. Appropriate footwear for the conditions shall be worn at all times.
10. It is even more important during hours of darkness or reduced visibility to wear reflective jackets or waistcoats that are reasonably clean.
11. Additional care shall be taken when working near watercourses in slippery conditions.
12. Make use of fog lights to increase visibility.
13. Use headlamps on low beam when driving in snow or fog.

## CHAPTER 64: SAFETY DURING DEMOLITION AND DISMENTLING

During demolition and dismantling the accidents are most likely due to:

i) fall of person
ii) fall of materials or objects
iii) sudden collapse of some of the structures
iv) fire and explosion
v) general accident due to handling or lifting of materials, obstructed access, striking against objects and poor housekeeping.

**A. Step to be considered before starting any demolition and dismantling:**

1. Proper study of the structure to be dismantled and the nearby structures.
2. Study of drawings of constructions of structure to be demolished to get an idea of stages and method of construction, and if no drawings are available, a complete study of structure shall be made. Allowance shall be considered between drawings and the actual construction for any deviation that may be possible.
3. Study of the manufacturing process, which was carried out in the structure to be demolished with a specific inquiry regarding use of toxic, flammable or explosive materials inside.
4. The type of wall, load bearing, partition or cross shall be ascertained and study its bonding.
5. Whether proper props and supports are provided on parts of structures not to be demolished.
6. Study of supports to any cantilever construction.

7. Planning about the stages of demolition and usually reverse methods than that followed in construction.
8. Proper support shall be provided to structures likely to be affected by method or work of demolition to prevent sudden collapse.
9. If there is a storage tank, find out about the material stored.
10. If other parts of building are likely to be affected, inform the concerned about the possible impact.
11. Barricades and warning sign shall be erected along every side throughout the length and breadth of a structure to be demolished to prevent unauthorized persons or animals from entering into the site of work during demolition operations.
12. All glass or similar material or article in exterior openings shall be removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines shall be put off and suitably capped and the concerned department of the appropriate authority or local authority shall informed and permission obtained wherever required before commencing any demolition work and wherever it is necessary to maintain water, gas or electric line or power during such demolition, such line shall be so located or protected with substantial coverings so as to protect it from damage and to afford safety to the workers and the general public.

**B. Step to be considered During Demolition and dismantling:**

1. The demolition work shall be done under experienced supervisor who has complete idea of methods of demolition and its steps.
2. Instruct and train each worker about the method and procedure of work to be done.
3. Tools to be used for demolition shall be kept ready and in good condition.
4. Whenever required provide protective wears such as shoes, helmet, safety belts etc. and explain to the workers the use of personnel protective equipment and the work requiring the use.
5. Proper scaffolding and support provided prior to starting the work, whenever necessary.
6. The demolition work shall be started according to plan and in reverse order than during construction.
7. The portion of structure not to be demolished shall be provided with necessary strong support.
8. The demolished material shall be stored away in such a way that no pressure is exerted on the site of the structure to be demolished.
9. Scaffolding will be fixed and railing shall be used where required.
10. It is dangerous to break RCC structure while sitting on it. A separate support structure shall be provided. While demolishing the RCC structure keep in mind the distribution of load by studying the structural drawings and site.
11. While cutting or demolishing steel parts, the remaining part shall be suitably supported.
12. While blasting, the work shall be done as per accepted and prescribed methods and administration shall be informed before and about the time and date of demolition and it shall not be done until all clear is obtained.
13. During demolition process, the site in-charge responsible for demolition work shall examine the walls of all structures adjacent to the structure to be demolished to determine the thickness, method of support to such adjacent structures and in case, such site in-charge has reason to believe that any of such adjacent structure is unsafe or may become unsafe during such demolition process, he shall not perform demolition activity affecting such unsafe adjacent structure unless and until remedial measures like sheet piling, shoring, bracing or similar other means so as to ensure safety and stability to such unsafe adjacent structure from collapse.
14. Any demolition of walls or partitions shall proceed in a systematic manner as per the standard safe operating practices and all work above each tier of any floor beams shall be completed before the safety of the supports of such beam is impaired.

15. Masonry shall be neither loosened nor permitted to fall in such masses or volume or weight as to endanger the structural stability of any floor or structural support.
16. No wall, chimney or other structure or part of a structure shall be left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration.
17. In the case of demolition of exterior walls by hand, safe footing shall be provided for the workers employed for such demolition in the form of sound flooring or scaffolds.
18. Walls or partitions which are to be demolished by hand shall not be left standing more than one storey high above the uppermost floor on which persons are working.
19. The site in-charge shall ensure that debris, bricks and other materials or articles are removed by means of chutes, buckets or hoists and through openings in the floors or by any other safe means.
20. Safe access to and egress from every building shall be provided at all times in the course of demolition by means of entrances, hallways, stairway or ladder runs which shall be so protected as to safeguard the workers using such means from falling material or articles.
21. All steel structures shall be demolished column by column and tier by tier and every structural member which is being demolished shall not be under any stress and such structural member shall be suitably lashed to prevent it from any uncontrolled swinging or dropping or falling.
22. Large structural members shall not be thrown or dropped from the building but carefully lowered by adopting suitable safe method.
23. Where a lifting appliance like a derrick is used for demolition, the floor on which such lifting appliance rests shall be completely planked over or supported and such floor shall be of adequate strength to sustain bearing load for such lifting appliance and its operation.
24. No materials or articles shall be allowed to store or kept on platform, floor or stairways of a building being demolished, provided that this clause shall not apply to the floor of a building when such floor is of such strength as to support safely the load to be superimposed by storing such material or articles.
25. An access to any stairway or passageway shall not be affected or blocked by storing any material or article.
26. Suitable barricades shall be provided so as to prevent materials or articles from sliding or rebounding into any space used by the workers.
27. Every opening used for the removal of debris from every floor which is not closed to access, except the top or working floor shall be provided with an enclosure from such floor to its ceiling, or such opening is so barricaded that no worker shall access to within a horizontal distance of 6metres from such opening through which debris is being dropped.
28. A person responsible for demolition work shall make continuous inspections during demolition process so as to detect any hazard resulting from weakened or deteriorated floors or walls or loosened materials or articles and that no worker shall be permitted to work where such hazard exist unless remedial measured like shoring or bracing are taken to prevent such hazards.
29. During the demolition of an exterior masonry wall or a roof from a point more than twelve metres above the adjoining ground level of such wall or roof, if persons below such wall or roof are exposed to falling objects, suitable and safe catch platform shall be provided and maintained at a level not more than six metres below the working level except where an exterior built-up scaffold is provided for safe and adequate protection of such persons.
30. Suitable and standard warning signs shall be displayed or erected at conspicuous places or position at the workplace.
31. The following requirements shall be fulfilled in case the mechanical method of demolition like use of swinging weight, clamshell bucket, power shovel, bulldozer or other similar mechanical methods are used for the purpose of demolition:
    (i) that the building or structure or remaining portion thereof shall be not more than twenty four metres in height;
    (ii) that where a swinging weight is used for demolition, a zone of such demolition having a radius of at least 1.5 times the height of the structure or portion thereof being so demolished shall be maintained around the points of impact of such swinging weight;

(iii) where a clamshell bucket is being used for demolition, a zone of demolition shall be maintained within eight metres of the liner of travel of such bucket;

(iv) that where other mechanical methods are being used to affect total or partial collapse of a building or other construction work, there shall be maintained, in the area into which the affected portion of such building or other construction work may fall, a zone of demolition at least 1.5 times the height of such affected portion thereof;

(v) that no person other than engaged workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition, which shall be provided with substantial barricades.

## CHAPTER 65: SAFETY IN USE OF HAND TOOLS & POWER OPERATED TOOLS

**A. General:**

1. All hand and power tools and similar equipment shall be maintained in safe condition.
2. When power operated tools are designed to accommodate guards, they shall be equipped with such guards, when in use.
3. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be properly guarded.
4. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapours or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards.
5. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.
6. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

**B. Hand tool:**

1. The unsafe hand tools shall not be used. Hand tools shall be replaced or repaired when found defective.
2. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads.
3. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.
4. Hand tools shall be used only for the specific purposes for which they are designed.
5. If there is a danger of an explosive atmosphere being ignited by sparks then non-sparking type of hand tools shall be used.
6. Only insulated hand tools shall be used while working on electrical machines / systems.
7. Hand tools shall be suitably heat-treated, finished and repaired by suitable skilled persons.
8. When not in use, sharp edged hand tools shall be provided with proper protection for the edges. Hand tools shall not be left unattended in the passageways. Suitable cabinets or covers shall be provided for hand tools.
9. Hammer shall be used in the right way.
10. Hammer shall not be held close to the head as it reduces the force of the blow. Hammer shall be held at such an angle that the face of the hammer and the surface of the object being hit are parallel in order to prevent damage both the surface being struck and the face of the hammer.

11. Hammers shall be kept free from grease and oil and repaired if necessary before they are used.
12. Hammers with defective handles shall not be used.
13. Handles shall be fitted carefully to the hammer head and securely fastened to them by means of a wedge. A hardened steel surface shall not be hammered otherwise small pieces of sharp, hardened steel may break from the hammer and also from the hardened steel.
14. A hammer handle shall not be used for bumping parts in assembly or as a pry bar, as such abuses may cause the handle to split and a split handle may cause bad cuts, injury or pinches to the operator. When a handle splits or cracks, it shall not be repaired by binding with string or wire. It shall be replaced by a new handle.
15. Hammering a hard metal plate / surface may cause the hammer to bounce and hit the user. Care shall be taken while doing similar works.
16. Wooden mallet shall not be left in the sun; otherwise it may dry out and cause the head to crack.
17. While loosening jammed nuts, wrench or spanner shall be pulled and not pushed as pushing may result in skinning of knuckles in case the wrench or spanner slips or the nut breaks loose unexpectedly. If it is impossible to pull the wrench or spanner then it may be pushed. The push shall be applied with the open palm of the hand.
18. Only that wrench or spanner shall be used which fits the nut properly.
19. Wrenches and spanners shall be kept clean and free from oil, grease etc.
20. The leverage of a wrench or spanner shall not be increased by inserting the handle inside a pipe. Increased leverage may damage the wrench or the work.
21. All wrenches shall be provided with case or kit and shall be returned with the case or kit after usage.
22. Hammering on wrenches and spanners shall be avoided. Use of wrenches / spanners as hammer shall not be allowed.
23. Wrenches and spanners with cracked or worn-out jaws or other defects shall not be used.
24. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs.
25. Attempt shall not be made to cut hardened steel wire or other similar objects with tin snips, it may dent or nick the cutting edges of the blades.
26. Snips shall be oiled and adjusted to permit ease of cutting. If the blades of the snips are too far apart they shall be adjusted.
27. Snips shall not be used as screwdrivers, hammers or pry bars. They break easily. Attempt shall not be made to cut heavier materials of thicker gauges than the snips are designed for.
28. Snips shall not be tossed into a tool box, where the cutting edges can come into contact with other tools. This will dull the cutting edges and may even break the cutting edges.
29. When not in use, snips shall be hung on hooks or laid on an uncrowned shelf or bench.
30. The blades in the hacksaw frame shall not be loose. Too much pressure shall not be applied on the blade during working; otherwise the blade may break causing injury to the hand.
31. The chisels shall be of suitable shape and edges kept sharp. Only that hammer shall be used which matches the chisel, that is, larger the chisel, heavier the hammer.
32. Goggles / face shield shall be used to protect eyes while using a chisel for chipping. If other workmen are close by, they shall be protected from flying chips by erecting a screen or shield to contain the chips.
33. The chisels with mushroom head shall be removed and dressed, before use.
34. Heads of chisels shall be kept free from grease and oil.
35. The handle of chisels shall be made of suitable materials, fitted with metallic ferrule on them to prevent from being chipped.
36. Files shall not be used without a tight-fitting handle.
37. File teeth shall be protected by hanging files in rack when they are not in use, or by placing them in drawers with wooden partitions. Files shall be wrapped in wax paper to protect their teeth and prevent damage to other tools before being stored.
38. Files shall be kept away from water and moisture so that they may not get rusted.

39. Files shall not be allowed to get oily, as it causes a file to slide across the work and prevents fast and clean cutting.
40. The files shall not be used for prying or pounding otherwise the tang will bend easily. The body is hard and extremely brittle, even a slight bend or a fall on the floor may cause a file to snap in two.
41. Files shall be cleaned by means of brushes. They shall not be struck against bolts or vices for cleaning purposes.
42. Ripsaws shall be used only for cutting along the grain of the wood and cross-cut saws shall be used for cutting across the grain of the wood.
43. The use of oil or paraffin on the blade may ease the work, particularly while cutting green timbers.
44. A saw which is not being used shall be hung up or stored in a tool box. A tool box designed for holding saws shall have notches that hold them on edge, teeth up. Storing saws loose in a tool box may result in the saw tooth to become dull or bend by coming in contact with other tools.
45. Tools shall not be piled on top of the bench, it may distort the blades.
46. There shall be no nails or other edge destroying objects in the line of the cut.
47. When sawing out a strip of waste, the strip shall not be broken by twisting the saw blade. This will dull the saw and may spring or break the blade.
48. When sawing, the waste side of work shall be supported to prevent splitting off.
49. It shall be ensured that the saw shall go through the full stroke without striking the floor or some other object. If the work cannot be raised high enough to obtain full clearance for the saw, the length of each stroke shall be carefully limited.
50. Screwdrivers shall not be used for electrical live circuit. Screwdriver shall not be turned with a pair of pliers.
51. While using a screwdriver, the work shall not be held by the hand, if the point slips it may cause an injury. The work shall be held in a vice, with a clamp or on a solid surface and any part of the body shall not come in front of the screwdriver blade tip.
52. Edges of screwdrivers shall be properly ground and shall be free from oil or grease.
53. Screwdrivers shall have smooth-surfaced handles and shall not be used as chisels.
54. Screwdriver with correct tip size shall be used for a particularly slot size of the screw. If screwdriver tip size is small than slot size of the screw, the tip may get twisted. Whereas if tip is bigger than slot, the screwdriver may slip while turning screw.
55. Screwdrivers with worn edges, bent shanks and splintered handles shall be discarded or repaired.
56. Attempt shall not be made to cut hard materials such as spring wire or hard rivets with the combination side cutting pliers, otherwise it may spring the jaws and if the jaws are sprung, it will be difficult thereafter to cut small wire with the cutters.
57. Combination side cutting pliers shall not be used to grasp large objects, tighten nuts, or bend thick sheets. Such operations will spring the jaws. When grinding the cutting edges, care shall be taken that excessive material from the jaws shall not be ground off than it is necessary to remove the nicks. Same amount of stock shall be ground from both jaws.
58. Pliers shall be coated with light oil when they are not in use. They shall be stored in a toolbox in such a manner that the haws shall not be damaged by striking hard objects. The pin or bolt at the hinge shall be kept tight enough to hold the two parts of the pliers in contact and the pivot pin shall be lubricated with a few drops of light oil.
59. Pliers shall not be used as substitutes for wrenches to tighten or loosen nuts.
60. When cutting wire under tension or spring wire in coils by means of pliers, at least one end of the wire shall be clamped or held down to prevent it from flying after being cut.
61. Points of punches shall be of suitable shape for the particular work to be done and shall be kept sharp.
62. Vices shall be kept clean and wiped with light oil after being used. Vices shall not be struck with a heavy object. Large work shall not be held in a small vice. These practices may cause the jaws to become sprung or otherwise damage the vice. The jaws shall be kept in good conditions. The screws and the slide shall be oiled frequently. When the vice is not in use, jaws shall be brought lightly together or shall be left with a very small gap. The handle shall be left in vertical position.

63. The swivel base of swivel jaw joint shall not be oiled; otherwise its holding power will be impaired.
64. Threads of C-clamps shall be cleaned and kept free from rust. The swivel head shall also be cleaned smooth and shall be grit free. If the swivel head becomes damages, it shall be replaced. For short storage the clamps shall be wiped clean with a light coat of engine oil and shall be hung on racks or pins, or shall be carefully placed in a tool box. For long storage a rust-preventive compound shall be applied to the C-clamp.
65. When closing the jaw of a vice or clamp, part of the body shall not come between the jaws or between one jaw and work.
66. When holding heavy work in a vice, a block of wood shall be placed under the work as a prop to prevent it from sliding down and falling on foot.
67. The jaws of a vice shall not be opened beyond its capacity otherwise the movable jaw will drop off, causing personal injury and possible damage to the jaw.
68. Shovels shall not be used for heavy prying. This may break the handle or bend the blade.
69. After use, shovels shall be cleaned and oiled. When using a shovel, it shall be ensured that working space is free, so that another worker shall not be injured when the shovel is swung.
70. Points or edges of crowbars shall be kept in good condition, to minimize slipping hazards.
71. When not in use, crowbars or similar tools shall be laid flat in safe places on the floor or platform and not leaning against a flat surface.
72. Carrying crowbars on shallers shall be avoided, as it may strike the persons walking aside.

**C. Power operated tool:**

1. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded.
2. The use of electric cords for hoisting or lowering loads shall not be permitted.
3. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled.
4. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm2 and that too with effective chip guarding. The 2 kg/cm2 pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes.
5. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded.
6. Only personnel who have been trained in the operation of the particular tool shall be allowed to operate power-actuated tools.
7. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure.
8. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired.
9. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end.
10. Loaded tools shall not be left unattended.
11. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles.
12. Driving into materials that can be easily penetrated shall be avoided unless backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side.
13. No fastener shall be driven into a palled area caused by an unsatisfactory fastening.
14. Only non-sparking tools shall be used in an explosive or flammable atmosphere.
15. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

16. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position.
17. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed, the marking shall be corrected to show the new speed.
18. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points.
19. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.
20. Cords and hoses shall be kept away from heat, oil and sharp edges.
21. Tools shall be disconnected from power source when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
22. Work piece shall be secured with clamps or a vise, freeing both hands to operate the tool.
23. The worker shall not hold a finger on the switch button while carrying a plugged-in tool to avoid accidental starting.
24. Tools shall be maintained with care. They shall be kept sharp and clean for the best performance. Maintenance and repairs shall be carried out only by the authorized electrician / mechanic.
25. Manufacturer's instructions in the user's manual shall be followed for lubricating and changing accessories.
26. Tool user shall keep good footing and maintain good balance while using the tool.
27. The proper apparel shall be worn by the user. Loose clothing, ties, or jewelry can become caught in moving parts.
28. Defective tools shall never be used.
29. Hazardous moving parts of a power tool shall be safeguarded. For example, belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains or other reciprocating, rotating, or moving parts of equipment shall be guarded if such parts are exposed to contact by employees.
30. Guards, as necessary, shall be provided to protect the operator and others from point of operation, in-running nip points, rotating parts, and flying chips and sparks.
31. Safety guards shall never be removed when a tool is being used.
32. Hand-held powered tools shall be equipped with a momentary contact "on-off" control switch.
33. To protect the user from electric shock, tools shall be earthed and double insulated and provided with ELCB of 30 mA sensitivity.
34. Double insulation shall be more convenient. The user and the tools are protected in two ways: by normal insulation on the wires inside, and by a housing that cannot conduct electricity to the operator in the event of a malfunction.
35. Electric tools shall be operated within their design limitations.
36. Footwear shall be used during use of electric tools.
37. When not in use, tools shall be stored in a dry place.
38. Electric tools shall not be used in damp or wet locations.
39. Work areas shall be well lit.
40. Before mounting a grinding wheel on a grinder, check the operating speed marked on the grinder and the rated safe speed of the grinder wheel. Grinding wheels are not to be mounted on grinders that operate in excess of the rated safe speed of the grinding wheel.
41. Adjusting the work rest or tongue guard while the grinding wheel is in motion is prohibited.

42. Inspect grinding wheel and discs on portable grinders before use for any cracks, damage, or wheels out of round or balance. Where any defect is evident, the wheel or disc must be removed from service immediately.
43. Check the grinding wheel mounting flanges for equal sizes and correct diameters. Flanges are to be at least one-fourth diameter of the wheel diameter.
44. Do not stand directly in front of any grinder when first starting it up.
45. Allow the wheel to develop its full speed before beginning work.
46. Never force the stock into the wheel of a fixed grinder or a portable grinder into the work to the point where the motor slows noticeably or the work becomes excessively hot.
47. Ensure that the wheel is properly dressed at all times.
48. Do not grind on the side of the wheel unless the wheel is specifically designed for this purpose.
49. Store grinding wheels in a safe place designated for that purpose.
50. Machines must be shut off when unattended.
51. Eye/face protection shall be worn by the employees working with pneumatic tools.
52. While working with noisy tools such as jackhammers, hearing protection shall be used.
53. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected. Clamp or positive locking device attaching the air hose to the tool will serve as an added safeguard.
54. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm2 pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface.
55. Screens must be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, or air drills.
56. Compressed air guns shall never be pointed toward anyone. Users shall never “dread-end” it against themselves or anyone else.
57. Compressed air shall not be used to clean or ventilate the body.
58. Airline hose connections shall be inspected regularly.
59. The fluid used in hydraulic power tools shall be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed.
60. The manufacturer’s recommended safe operating pressure for hoses, valves, pipes, filters and other fittings shall not be exceeded.
61. Hose joints shall conform to the recommendations of manufacturer.
62. The tool shall not be used when there is an oil leak.
63. All jacks (lever and ratchet jacks, screw jacks and hydraulic jacks) shall have a device that stops them from jacking up too high.
64. Manufacturer’s load limit shall be permanently marked in a prominent place on the jack and shall not be exceeded.
65. A jack shall never be used to support a lifted load. Once the load has been lifted, it shall immediately be blocked up.
66. Use wooden blocking under the base if necessary to make the jack level and secured. If the lift surface is metal, place a 1-inch (25.4mm) thick hardwood block or equivalent between it and the metal jack head to reduce the danger of slippage.
67. To set up a jack, following precautions shall be taken up:
    (i) The base shall rest on a firm level surface.
    (ii) The jack shall be correctly centered.
    (iii) The jack head shall bear against a level surface and
    (iv) The lift force shall be applied evenly.
68. Jacks shall be inspected before each use and lubricated regularly. If a jack is subjected to an abnormal load or shock, it shall be thoroughly examined to make sure that it is not damaged.
69. Lever shall be removed when it is not used, as it may create tripping hazard.
70. If oil leaks from the hydraulic jack, it shall not be used.

**D. Woodworking tools:**

1. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position.
2. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed, the marking shall be corrected to show the new speed.
3. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points.
4. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

## CHAPTER 66: SAFETY IN GRINDING & MACHINING

1. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation.
2. Grinding machines shall be equipped with suitable safety guards.
3. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 90 degree, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 120 degree. In either case, the exposure shall begin not more than 8.65 degree above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel.
4. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel.
5. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard.
6. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of accidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180 degree.
7. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges.
8. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used.
9. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects.
10. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place.
11. All employees using abrasive wheels shall be protected by suitable eye protection equipment.
12. Wear proper safety equipment such as goggles, hand gloves, grinding apron and safety shoes before starting Grinding.

13. Ensure proper earthing of the grinding machine.
14. Ensure to wear breathing mask to avoid inhaling fine metal dust.
15. Ensure the grinder-man is properly insulated.
16. Ensure there is no loose connection in the system.
17. Position the job properly and firmly.
18. Ensure the grinding sparks are not directed towards any person, flammable materials or any sensitive system for heat.
19. Do not leave the grinding machine ON when not required.
20. Since the grinding machine operates at a high speed, ensure safety guard over the grinding wheel.

## CHAPTER 67: SAFETY IN OPERATION OF DIESEL GENERATOR SET

1. Correct any abnormal condition.
2. Ensure that there is no oil leakage. In case of oil leakage, arrest it immediately & keep the oil in a tray for reuse.
3. Check the cooling water temperature & ensure that it is maintained below 90°C.
4. Ensure that the coolant is added as per required ratio in the system. Used coolant to be collected in a container and left for natural evaporation; the leftover to be mixed with used oil for onward disposal.
5. Ensure that lube oil temperature is maintained below 105°C.
6. Avoid spillage of oil & diesel on the floor. In case of spillage wipe the floor with cloth and put the cloth in the waste bin for onward disposal.
7. Put used filters in the designated bins.
8. Check all electrical connections for tightness to prevent any sparking.
9. Maintain optimum loading (80 %) on DG Set for efficient output, whenever the DG Set is in continuous operation. Do not overload.
10. Whenever the DG Set is not in regular use, carry out checks by operating for a few minutes daily.
11. Ensure earthing is in place and isolation is working properly.
12. Ensure that no emission is taking place at ground level and no gas leakage is there from the silencer.
13. Ensure that you are using ear plug / muff while working near operating DG Set(s).
14. Arrangement for First-Aid to be kept ready.
15. Firefighting arrangements to be regularly checked for their effectiveness.
16. Ensure that lube oil is changed at desired intervals; collect the used oil and dispose as per the requirements of the Hazardous Wastes (Management, Handling and Trans-boundary) Rules.
17. Do preventive maintenance as per Schedule and maintain records. Ensure that the external agency responsible for the same is carrying out all desired checks at quarterly frequency.
18. Do not smoke inside DG Room and also never store inflammable materials near the DG Sets.

## CHAPTER 68: SAFETY IN WORKSHOP AND GARAGE

1. Do not wear loose clothing or jewelry around machinery. Where required, wear protective equipment, such as goggles, safety glasses, masks, gloves, hair nets, etc. appropriate to the task.
2. Pile materials, skids, bins, boxes, or other equipment so as not to block aisles, exits, firefighting equipment, electric lighting or power panel, valves, etc. Fire Doors and Aisles must be kept clear.
3. Use compressed air only for the job for which it is intended.
4. Shut down running machine before cleaning, repairing, or leaving it.
5. Do not tamper with electric controls or switches.
6. Do not operate machines or equipment until properly instructed and authorized to do so by the supervisor.
7. Use designated passages when moving from one place to another; never take hazardous shortcuts (i.e., between moving equipment or across roadways).
8. Do not adjust, clean, or oil moving machinery.
9. Keep machine guards in their intended places.
10. Clean up spilled liquid, oil, or grease immediately.
11. Wear hard-sole shoes and tight fitting clothing.
12. Keep wiring, heating and ventilation systems in good condition.
13. Provide adequate lighting with no glare; supply additional local lighting for hazardous procedures to ensure increased vision and reduced eye strain and fatigue.
14. Replace any flickering fluorescent tubes - the "strobe" effect may make some moving parts appear as not moving.
15. Designate separate areas for operations such as welding, cleaning, painting, lubricating and battery maintenance. Allow adequate floor space for the volume of work expected.
16. Use tools and service equipment only for the tasks for which they are designed.
17. Keep power tool guards and safety devices in place and functional.
18. Inspect and service fire extinguishers regularly.
19. Keep first aid kits fully stocked.
20. Keep floors and benches clean to reduce slipping and tripping hazards.
21. Place heavy items on shelves at waist height. Identify the weight of unfamiliar loads and load limits on shelving.
22. Clearly label all chemicals and materials. Check the material safety data sheet (MSDS) for storage and handling instructions.
23. Label flammable and combustible materials clearly and store in a separate place, away from heat and ignition sources.
24. Use only approved safety containers for flammable and combustible liquids.

## CHAPTER 69: COLOUR CODING OF PIPELINE

1. In order to proper identification of the contents of the pipelines, the system of colour coding is introduced as per IS: 2379; 1990.
2. This colour coding system consists of a ground colour and colour bands superimposed on it. Display colour coding boards at conspicuous places to educate people working on or around the pipelines. Flow directions shall also be provided on the pipelines to indicate material flow direction inside the pipeline.
3. The ground colour identifies the basic nature of the fluid carried and also distinguishes one fluid from another.
4. Ground colour shall be applied throughout the entire length for uninsulated pipes, for insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel, plastic, etc, ground colour coating of minimum 2 m length or of adequate length, not to be mistaken as colour band, shall be applied.
5. Colour bands are superimposed on the ground colour to distinguish: a) One kind or condition of a fluid from another kind or condition of the same fluid, or b) One fluid from another but belonging to the same group, for example carbon monoxide from coke oven gas or diesel fuel from furnace fuel.
6. Appropriate quality of paints conforming to relevant Indian Standards, shall be used for colour marking. It is recommended that the paints used shall produce a glossy finish.
7. Procedures for application of colour code and colour band in the pipeline are detailed in the standard.
8. The ground colour as prescribed in the standard for application in the pipeline is mentioned below:

| Sl. No. | Substance | Colour |
|---|---|---|
| 1 | Water | Sea green |
| 2 | Steam | Aluminum |
| 3 | Mineral, vegetable and animal oil or combustible liquid | Light brown |
| 4 | Acids | Dark violet |
| 5 | Air | Sky blue |
| 6 | Gases | Canary yellow |
| 7 | Alkalis | Smoke grey |
| 8 | Other liquids/gases which do not need identification | Black |
| 9 | Hydrocarbons/ organic compound | Dark admiralty grey |

9. The standard also detailed about colour coding as applicable to pipeline for general services, industrial gases, hydrocarbons & naptha and medical gases.
10. The colour of the pipeline never be changed as the same may create unsafe condition in the plant.

## CHAPTER 70:-GENERAL SAFETY GUIDE LINES FOR VARIOUS VALVES

1. Follow all safety guidelines of safety.

1. Check mode of operation of valves i.e. motor operated, pneumatically operated, hydraulically operated, manually operated etc.

2. Check the position of valves i.e. close/open/in-between and confirm with remote and local feed back/check back. If the positions are not matching inform respective maintenance department.

3. After or during the operation of any valves if any abnormality like gland leak etc. is observed then restores the original position of valve or keep the valve in position where the abnormal behaviour is minimized and inform respective maintenance department.

4. Check the housing of the area in the vicinity of valve to be operated, if not proper then inform respective maintenance department, or Min Control Room.

5. Check the type of valve i.e. isolating or control etc.

6. Confirm the valve is easy to operate.

7. Gate valves are always to be operated in full open or full close condition.

8. Avoid frequent operation of high-pressure valves as far as possible to avoid any gland leak.

9. **For Motor Operated Valve**:

- Confirm from working party or Main Control Room whether valve operation is to be done electrically or manually.
- For electrical operation check the direction of operation by giving an impulse command if possible and if direction is OK then operate it fully.
- If manual operation is to done then first confirm that motor breaker is off and then valve can be operated in the similar way as that of manual valve.

10. **For Manual Operated Valve**:

- Arrange right size of spanner as per size and location of valve and also arrange hand gloves and other safety accessories as per specific requirement of the valve to be operated.
- Fix the spanner in such a way so that enough space is available for spanner movement and also confirm that spanner grip is proper and there is no slipping or sliding of spanner. This can be confirmed by applying force initially. Change the spanner if required.

Gradually start operating the valve (close/open as per requirement).

12. **For Pneumatically Operated Valve:**

- Check instrument air supply isolating valve is open and thus air is available for valve operation.
- Reset pneumatic air lock, if any and check the direction of valve by giving small command from remote or local and then valve can be further operated from remote or local as per requirement.

- If valve operation is not possible pneumatically then it can be done manually in the same as given for manual operating valve by isolating its instrument air supply.

13. **For Hydraulically Operated Valve**:

- Check hydraulic circuit is properly lined up and enough hydraulic pressure is available for valve operation.

- Check for any leakage during or after the operation of valve in hydraulic circuit.

## CHAPTER 71:-SAFETY REQUIREMENT IN GAS TURBINE

Most of the gas turbines use Natural Gas (main composition is methane gas)/Naphtha as fuel. Both natural gas and naphtha are explosive fluid. The primary hazards associated with Gas Turbine are fire and explosion. Hence the following safety features should be incorporated in gas turbine.

1. Gas Turbine should preferably be housed in acoustic enclosures with proper ventilation arrangement for turbine cooling. These enclosures should be equipped with separate fire extinguishing system.

2. Fire suppression in turbine enclosures should be achieved by injecting a non-inflammable inert gas (which is stored in cylinder) in to the fire-affected region. This removes the free oxygen, which support combustion, and results in extinguishing the fire.

3. Carbon Dioxide should preferably be used as fire extinguishing medium as it has many desirable properties, electrically non conducting, easy to clean up, non-corrosive gas etc.

4. Fire protection system should be totally automatic and should have higher level to reliability. Sufficient numbers of suitable type of fire detectors in the form of heat detectors, rate change of heat detectors, smoke detectors etc. should be used to detect the fire and initiate the release of inert gas from cylinder to the location of fire. Automatic release of gas can be achieved by use of electromechanical system such as solenoid-operated blade rupturing diaphragms fitted on cylinder or electrical motor operated actuators, opening cylinder valves etc.

5. Periodical trial of the system should be taken to ensure reliability, records thereof should be maintained and any defect noticed should be immediately attended.

6. The fire protection system should have manual actuation facility also, which can be used during the failure of automatic actuation.

7. Detectors should also be provided to initiate the alarm in the event of leakage of carbon dioxide or the gas used for fire extinguishing.

8. Hydrocarbon detectors with annunciation facility should also be provided at suitable places in the turbine enclosures to detect leakage of natural gas/naphtha.

9. All the miscellaneous electrical equipments used in the turbines enclosures should be flame proof and there should not be any possibility of hot spots or sparks being generated in the electrical equipment.

10. The gas turbine enclosure should be suitably protected because of its high operating temperature and multiple fire hazards i.e. leakage of lube oil, flue gas, natural gas/naphtha, oil soaked insulation etc.

11. Welding or any hot jobs should be prohibited in the vicinity of gas turbine. In case it is essential, adequate precautions should be taken under the supervision of authorized person.

12. Operator should have a high level of skill, knowledge, and experience of avoid dangerous situation.

13. Minimum failures and incidents should be ensured by paying attention to careful and systematic operation and maintenance procedures.

14. Fail-safe and cut off mechanism should be provided whenever practicable to ensure that failures follow a “Low risk path”.

15. Turbine protection system should bring the turbine to safe operating conditions, wherever possible and should shut down the turbine completely when no other option remains.

16. All tanks and fuel line should be regularly checked for deterioration and renewed where necessary, paying particular attention to the possibility of the hardening of the flexible pipes and seals in the vicinity of joints which are subjected to high pressure.

17. Smoking and other source of ignition should be prohibited with a radius of 50 m. Signs designating the flammable areas should be displayed.

## CHAPTER 72: BOILER SAFETY AND SAFETY GUIDELINE FOR WASTE HEAT RECOVERY BOILERS

There are different types of boilers using different technologies and are available in wide variety of sizes and applications. Hazards encountered and risk involved may differ based on these factors. Erection, operation and maintenance of boiler is a skilled job. There are various hazards involved in different stages. The important safety tips during operation along with major hazards encountered during operation and maintenance and their corrective measures are mentioned below:

**A. Pre startup checks:**

1. Ensure boiler furnace is cleaned and all manholes are closed.
2. Adequate water in a boiler drum so that no increase of temperature of boiler tube.
3. Safety and feed valves are in proper order.
4. All the gauges and transmitters are calibrated.
5. Feed pump is working properly.
6. Availability of required personal protective equipment.

**B. Start up:**

1. Light up the boiler as per the sequence laid down by original equipment manufacturer (OEM).
2. Increase the steam pressure as per OEM guideline.
3. Keep the required level of water in the drum during operation.
4. Blow of valve is completely closed and tight.
5. Ensure the boiler drum level control and standby boiler feeding pump are on auto mood.

**C. Monitoring during operation:**

**a) Pressure gauge:**

1. Ensure that the gauge is showing pressure correctly.
2. Ensure that the maximum allowable pressure is marked by red colour mark.
3. Ensure the glass of pressure gauge is clean.

**b) Safety valve:**

1. Check daily the safety valve.
2. Once the valve has been set, do not disturb it.
3. While setting the safety valve, do not abruptly increase the pressure.
4. Maintain the pressure within the allowable limit.

**c) Water gauge:**

1. It shall blow time to time.
2. No leakages in a cock.
3. Check the water gauge glass in every shift.

**d) Steam pipe:**

1. Ensure that steam pipe is properly drained before the opening of the stop valve.

**e) Water chemistry:**

1. Water chemistry shall be maintained as per the guideline of OEM.

**D. Operation:**

**a) Furnace back fire:**

1. This is a result of furnace draught instability or wrong operation.

2. Operation procedure shall be documented and followed.
3. Personnel involved shall be qualified as per the Indian Boiler Regulations norms.
4. Interlocks and sensors shall be in line and tested periodically.

**b) Steam leakages:**

1. Steam is often found leaking from the valve glands or vents.
2. These leakages result in accumulation of condensate at high temperature in the drain lines or vent pipes.
3. To avoid contact with condensate, vents and drains shall be routed safely to a distance or a common drain.

**c) Fire:**

1. Fire in the boilers occurs due to oil leakages in the furnace or boiler.
2. Unstable draught results in fire in the fuel conveying lines.
3. During start up leakages in the firing fluid like LDO may also result in fire.
4. Preventive maintenance of equipment shall be done mandatorily to avoid any incidents.
5. Fire may also result from loose electrical contacts and overloading of cables. This requires periodic inspection and repair.

**d) Skin burns:**

1. Operation of boiler involves draining of bed ass and steam from various points. Proper handling through tools may reduce the risk of burns.
2. Insulation on hot surfaces shall be done to avoid skin burns, boiler suit shall be worn by the operators at all the time.

**e) Fall of person:**

1. During operation the operator or his assistant requires to work at height. Proper approach to the workplace at height and platform shall be provided for safety of the worker.

**f) Boiler explosion:**

This may occur due to following reasons:

1. Instantaneous combustion of accumulated fuel in the combustion chamber of oil or gas fired boiler. Purging of furnace with the built in safety features will take care of fuel accumulation. Bypass of instrumentation system may lead to abnormal operation.
2. Salt deposition on the water side causes the tubes to overheat and rupture as heat is not transferred to the water inside the tube.

**I.** To avoid this, water chemistry is to be maintained properly.

**i) Failure of boiler tubes causes:**

1. Silica deposition in super heater tubes: Presence of reactive silica and colloidal silica can cause deposition of same in super heater tubes. To avoid this silica content in steam shall not exceed 0.02 ppm. This concentration may vary for different boilers.

**ii) Corrosion of tubes from water side:**

1. Dissolved oxygen in feed water can cause rapid corrosion of tubes.
2. Auxiliaries such as de-aerator are provided to separate dissolved oxygen from the feed water.
3. Chemicals such as Hydrazine and Sodium Sulphide are added in high pressure and low pressure stages to remove dissolved oxygen from feed water.
4. Oxygen level in feed water shall be maintained below 0.007 ppm.

**(iii) Corrosion of tubes on the fire side:**

Primary causes of this are presence of sulphur in coal, low stack temperature (110 degree below dew point), boiler operating at part load and frequent start up and shut down. All of above is to be monitored and desired levels are to be maintained for safe operation of boiler.

**g) Rotating parts:**

Fuel feed system and fans for supplying air for combustion involve use of rotary motion. Use of machine guards on the couplings, drivers and at transfer points can save life of humans.

**h) Electrical shock:**

Operation of boiler requires operation of electrical equipment and a person may get electrical shock while start up or shut down. Inspection and testing of measuring tools, isolators and hand tools shall be carried out periodically.

**E. Maintenance:**

**a) Working in confined spaces:**

To repair or maintain the boiler, person working inside the boiler is exposed to hot surface inside the
boiler as well as high temperature fuel or bed material. Person shall be allowed to enter the boiler only after cooling, cleaning, draining of boiler and purging of moisture or vapour into it. PTW for confined space shall be issued only after this activity.

**b) Skin burns:**

Maintenance activity involves working close high temperature surfaces and areas. Accidental contact with these surfaces may result in skin burns. Contact with hot steam and condensate may result in serious injuries. Persons involved shall be wearing coveralls/boiler suits at all times during cooling, draining and maintenance.

**c) Electrical shock:**

Maintenance of boiler involves fabrication activities like welding. This activity may result in electric shock due to improper earthing of job and welding machine. Welder may get electric shock while working on wet surface or when his body becomes conductive after excessive sweating. This hazard also encountered while using power tools like portable grinders and drill machines. Connecting the equipment to earthing and connecting through ELCB is a basic requirement to avoid all of above. Lock out and tag out procedure shall be followed for electrical maintenance activities.

## SAFETY GUIDE LINES FOR BOILERS AND WASTE HEAT RECOVERY BOILERS

1. Never walk bare foot any where on boiler floors( indoors & outdoors)
2. Thermal resistant gloves suitable for temperature range should be used while working on steam lines and equipments.
3. Never start work in a plant without tracing pipelines and learning the location and purpose of every valves etc.
4. Always proceed to proper valves or switches without confusion.
5. Explosion doors, vents, valves etc should be kept free from obstruction and in good working condition.

6. Remember to keep system drain valves open before charging the steam to cold pipelines. There may be water in pipe because of condensation. Water draining should be ensured before steam charging.

7. Never open or close any valves suddenly on high pressure steam/ water lines, which may cause severe hammering or even damage the weakest part any where in lines.

8. Always check water level in the gauge glass with the gauge cocks at least once in each shift daily and any other time if there is doubt regarding the accuracy of gauge glass indication.
9. While inspecting flue gas path, make sure that the Guillotine Dampers is fully closed, and the Air shield blowers are on. In case the Guillotine Damper is not reliable, the Gas turbine must be shut down.

10. Never open an access to the flue gas path without taking proper safety measures. Any such activity must be supervised by experienced engineers. The supervisor should ensure use of PPE as required.

11. Never change the pressure setting of safety valves with out permission of competent authority,

12. Safety valves should be checked for its healthiness as per I.B.R.

13. Always keep out loiterers and entrust plant operation in the hand of trained persons.

## CHAPTER 73: PREVENTION OF ELECTRICAL HAZARDS

1. Do not touch loose or fallen wires unless you are a trained electrician.
2. Place insulating mats or other electrically non-conductive material on the floor at Switchboards, power control panels, or other electrical devices where there is a potential for Shock hazard.
3. Electrical equipment and illumination devices used in wet or potentially wet areas shall have Circuit breaking arrangements.
4. Adequate clearance around electrical panels and circuit breaker boxes must be maintained. Electrical panels and circuit breaker boxes shall be labeled with the equipment controlled by the panel or box.
5. Check that the equipment is properly grounded. If applicable, check that surrounding metal objects, fencing, metal enclosures, etc. is grounded.
6. Check that inspection and cover plates are in place. These plates are required to be in place except when inspection or maintenance is being performed.
7. Powered equipment must be stopped and locked out before maintenance or repairs are performed unless the equipment is designed or fitted with safeguards to protect personnel during maintenance/repair. Lockout/tag-out procedures will include locking out electrical, mechanical and stored energy as appropriate.
8. Use fuse tongs or hot-line tools to remove/replace fuses in high potential circuits. Do not remove or replace fuses by hand if the circuit is still energized unless the circuit is designed or had a special device to prevent shock when fuses are changed.
9. Shut off the power source or check that wires are properly energized before using metal tools to repair bare wires, trolley wires, or electric rails.
10. Check that transformers are enclosed and that the housing in good condition. Check for leaks or staining on the transformer or surrounding surface.
11. Transformers near vehicle or equipment travel ways shall be protected from impact hazards.
12. Electrical terminals or junction boxes shall be guarded.
13. Do not use damaged electrical cords/cables until repaired by a certified electrician. Do not remove a plug that has broken off in a receptacle unless you are a trained and certified electrician.
14. Check that plugs are free of dirt, grease, oil, etc. before using.

15. Cords/cables used in the workplace shall be 3-pronged and grounded. Do not remove the grounding prong or attach a 2-prong adapter to a 3-prong plug and grounded.
16. Do not use extension cords unless there are no other options. Check that the extension cord is adequate for the power output required. Use an extension cord of the same type and size as the cord of the electrical equipment to be connected.
17. Extension cords shall not be substituted for hard wiring and shall not be passed through Wall openings or under doors or windowsills. It shall never be secured in place with staples, nails, or other sharp objects.
18. Do not overload extension cords or electrical outlets.
19. Does not use an extension cord near oil or water unless the cord cover is resistant to oil and/or water.
20. Place cords and cables so that they do not create a trip hazard. Do not use cords/cables on stairways, in doorways, in passageways, or in areas where they may be exposed to excessive heat.
21. Do not step on cords/cables or drive over unshielded cords/cables with mobile equipment.
22. Do not drape cords/cables over lighting fixtures or metal structures without softeners or other insulators or adequate protection.
23. Do not pull on the cord when removing a plug from a receptacle.
24. Do not estimate or “guess” the voltage of a power line; when in doubt, contact the person or organization that operates or controls the electrical power source.

## CHAPTER 74: SAFETY IN USE OF ELECTRICITY

Voltage levels as defined in IE Rule 1956:

1. Low- Where the voltage does not exceed 250 volts under normal conditions subject, however, to the percentage variation allowed by these rules.
2. Medium- Where the voltage does not exceed 650 volts under normal conditions subject, however, to the percentage variation allowed by these rules.
3. High- Where the voltage does not exceed 33,000 volts under normal conditions subject, however, to the percentage variation allowed by these rules.
4. Extra high- where the voltage exceeds 33,000 volts under normal conditions subject, however, to the percentage variation allowed by these rules.

Some important definitions:

1. Live – Electrically charged.
2. Dead – At or about earth potential and disconnected from any live system provided that apparatus separated from a live conductor by a spark gap shall not be deemed to be dead.
3. Apparatus – Electrical apparatus and includes all machines, fittings, accessories and appliances in which conductors are used.
4. Installation – Any composite electrical unit used for the purpose of generating, transforming, transmitting, converting, distributing or utilising energy.
5. System – An electrical system in which all the conductors and apparatus are electrically connected to a common source of electric supply.
6. Switchgear – Switches, circuit breakers, cut-outs and other apparatus used for the operation, regulation and control of circuits.
7. Switchboard – An assembly including the switchgear for the control of electrical circuits, electric connections and the supporting frame.
8. Earthed / connected with earth – Connected with the general mass of earth in such a manner as to ensure at all times an immediate discharge of energy without danger.
9. Guarded – Covered, shielded, fenced or otherwise protected by means of suitable casing, barrier, rails or metal screens to remove the possibility of dangerous contact or approach by persons or objects to a point of danger.

**A. General:**

1. Only Authorized, trained and experience electricians shall be appointed to do any work on electrical equipment and installations. No Electrician without ITI in Electrician trade or those who have not passed Wireman's certificate shall be allowed for electrical work.
2. Before commencement of any building or other construction work, adequate measures shall be taken to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuit which may cause electrical hazard during the course of his employment and suitable warning signs shall be displayed and maintained at conspicuous places in Hindi and in local language understood by the majority of the workers.
3. In workplaces where the exact location of underground electric power line is not known, the building workers using jack hammers, crow bars or other hand tools which may come in contact with a live electrical line shall be provided with approved insulated protective gloves and footwear.
4. As far as practicable, no wiring or cable, which may come in contact with water or which may be mechanically damaged or which may result in electric shock shall be left on ground.
5. All electrical appliances and current carrying equipment used shall be made of sound material and adequately earthed.
6. All temporary electrical installations shall be provided with earth leakage circuit breakers.

7. It is required that all portable power-driven hand tools are provided with double insulation to secure a high degree of protection from electrical hazards.
8. Electrical installations shall comply with the requirements of any law for the time being in force, especially the Indian Electricity Act/Rules in particular with specific reference to the following:
   (i) All parts of installations shall be of standard construction not lower, from the safety point of view, than the national standards, as applicable. All parts of electrical installations shall be so constructed, installed and maintained so as to prevent electrical fires, explosion and shock.
   (ii) Earthing of metal work of electrical equipment, other than the parts which carry current, shall be provided and will conform to Electricity Act and IS: 3042 – 1986 (code of practice for earthing).
9. All parts of electrical installations shall be so constructed, installed and maintained as to prevent the danger of electric shock; fire and external explosion.
10. It shall be made impossible for circuit breakers to be opened or closed inadvertently, by gravity or by mechanical impact.
11. Use of rubber gloves and rubber gum boots of tested quality where electric shock is likely to occur shall be provided, but these shall not be considered as providing adequate protection against the risk of electric shock in lieu of inbuilt safety arrangement in the system.
12. First-aid boxes, instruction for restoration of persons affected by electric shock shall be made available.
13. Arrangement shall be made for sufficient number of CO2/chemical powder type fire extinguishers/sand buckets etc.
14. No electrical circuits shall ever be overloaded to the dangerous extent or beyond the rated capacity.
15. In confined areas, only 24 volt supply shall be used for equipment, including hand-held portable tools and hand lamps.
16. All electrical appliances and outlets shall be clearly marked to indicate their purpose and voltage.
17. All authorized persons shall be trained on artificial respiration and be competent to apply the instructions given in the 'Shock Treatment Chart' in case of electrocution of a co-worker.
18. Check that no one is in contact with the apparatus or circuit. The system is ready for charging and that all men, materials, temporary shorting and / or earth connections have been removed.
19. Persons who were previously working on the apparatus or circuit, shall be warned that the power supply will be switched on so as to avoid any misunderstanding and danger.
20. Always refer to the log book specially provided for recording the isolating the apparatus and circuits.
21. Never reclose or energize any system until you have checked and satisfied yourself that any request for making 'dead' has been correctly cancelled and that no danger is present.

**B. Fuses:**

1. Fuses shall bear markings indicating their rated current, whether they are of the fast or slow-breaking type and, as far as practicable, and their rated breaking capacity. Fuses as per need and of correct rating shall be used in the circuit.
2. Effective measures shall be taken to ensure that persons removing or inserting fuses will not be endangered, in particular by any adjacent live parts.
3. In case of blow of fuses only after finding out and correcting of the fault, new fuses shall be provided in the circuit.

**C. Switches:**

1. All switches shall be of enclosed type and so installed and earthed as to prevent danger in their operation.
2. Use of switches, which may connect or disconnect circuit through gravity, shall not be used.

**A. Motors:**

1. Motors shall be so installed as to ensure that they can be adequately cooled.
2. Motors shall be effectively protected against over current.
3. Whenever the motors installed are in the open area where there is the possibility of fall of liquid corrosives or otherwise, it shall be suitably protected with covering.
4. Earthing shall be connected to all motors, generators etc. as prescribed in the Indian Electricity Rules, amended from time to time.

**B. Connections:**

1. At points where conductors are joined, branched or led into apparatus, they shall be mechanically protected and properly maintained.
2. Conductors shall be joined, branched or led into an apparatus through junction boxes, bushings, glands or equivalent connecting devices.
3. Junction boxes or plug-out-socket couplings shall be used for joining cables wherever practicable.
4. When parts of conductors are joined together, or conductors are joined to one another or to an apparatus, the attachment shall be made by screwing, clamping, soldering, riveting, brazing, crimping, or equivalent means. Loose connections shall not be provided in any case.
5. Cable joints, junction boxes and connectors shall be protected as far as practicable, against traffic, fall of ground, water and other sources of damage.
6. Whenever armoured cables are joined, the junction boxes shall be bridged by a suitably conducive bond between the armouring of the cables.

**C. Portable electrical equipment:**

1. The supply of electricity to portable apparatus shall not exceed 250v.
2. Hand-held and portable machines shall be equipped with a built-in switch to switch off power in case of emergency.
3. Hand-held electrically operated tools shall be provided with built-in switch to disconnect the circuit when the tool is not being used.
4. Portable electrical tools, unless flameproof, shall not be used in flammable or explosive atmosphere.
5. Only three-core cable shall be used for single-phase operated tools with the third core connected to earth.

**D. Hand lamps:**

1. Hand lamps shall be equipped with strong cover of glass or other transparent material.
2. Portable lamp holders shall have:
   (i) all current carrying parts enclosed;
   (ii) insulated handle; and
   (iii) they shall operate at 24 Volt.

**E. Inspection & maintenance:**

1. All electrical equipment shall be inspected before it is taken into use to ensure that it is suitable for its purpose of use.
2. At the beginning of every shift every person using electrical equipment shall make a careful external examination of the equipment and conductors.
3. Periodic inspections, testing, maintenance of all electrical equipment is to be made and record shall be maintained.
4. Before any work is begun on conductors or equipment:
   (i) the current shall be switched off;

(ii) adequate precautions shall be taken to prevent the current from being switched on again;
(iii) the conductors or the equipment shall be tested to ascertain that they are dead;
(iv) the conductor and equipment shall be earthed and short-circuited; and
(v) nearby live parts shall be adequately protected against accidental contact.

5. After work on conductors and equipment, the current shall only be restored after the withdrawn of PTW and on the orders of authorized person who issues PTW.
6. Electricians shall be provided with adequate tools, and person protective equipment, such as rubber gloves, mats etc.
7. All conductors and equipment shall be considered to live unless there is certain proof to the contrary.

**F. Work in the vicinity of electrical installations and guarding of live apparatus:**

1. When any excavation is to be made or any bore-holed sunk, it shall be ascertain that whether there are any underground conductors, in or in dangerous proximity to, the zone of operations.
2. No work shall be done in dangerous proximity to a conductor or an installation until it has been made dead.
3. Before work begins, work permit shall be obtained from the Engineer in-charge if live electricity lines/circuit are passing in close vicinity.
4. Before the current is restored, it shall be ensure that no work remain on the work site.
5. If conductor or an installation in the neighborhood of which work is to be done cannot be made dead, special precautions shall be taken and special instructions given to the workers so as to prevent danger by adequately enclosing or fencing.

## CHAPTER 75: SAFETY IN HANDLING ELECTRICAL EQUIPMENT

Guidelines as per Rule 36 of Indian Electricity Rule, 1956:

1. The owner of every MV, HV and EHV installation shall affix permanently in a conspicuous position a danger notice in Hindi or English and the local language of the district, with a sign of skull and bones (of a design as per the relevant IS No. 2551) on –
   a) Every motor, generator, transformer and other electrical plant and equipment together with apparatus used for controlling or regulating the same;
   b) All supports of HV and EHV overhead lines which can be easily climbed upon without the aid of ladder or special appliances;
   c) Luminous tube sign requiring high voltage supply, X-ray and similar high frequency installations: 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:

Provided further that where the generator, motor, transformer or other apparatus is within an enclosure one notice affixed to the said enclosure shall be sufficient.

Guidelines as per Rule 36 of Indian Electricity Rule, 1956:

1. Before any conductor or apparatus is handled adequate precautions shall be taken, by earthing or other suitable means, to discharge electrically such conductor or apparatus, and any adjacent conductor or apparatus if there is danger there from, and to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon. Every person who is working on an electric supply line or apparatus or both shall be provided with tools and devices such as gloves, rubber shoes, safety belts, ladders, earthing devices, helmets, line testers, hand lines and the like for protecting him from mechanical and electrical injury. Such tools and devices shall always be maintained in sound and efficient working conditions.
2. No person shall work on any live electric supply line or apparatus and no person shall assist such person on such work, unless he is authorized in that behalf, and takes the safety measures approved by the Inspector.
3. Every telecommunication line on supports carrying a high or extra-high voltage line shall, for the purpose of working thereon, be deemed to be a high voltage line.

**A. Earthing of equipment:**

**a) Earthing definitions:**

1. DEAD: -The term used to describe a circuit / equipment to indicate that a voltage is not applied.
2. LIVE PART: -A conductor or conductive part intended to be energized in normal use including a neutral conductor.
3. NEUTRAL CONDUCTOR: -A conductor connected to the neutral point of a system and capable of contributing to the transmission of Electrical Energy.
4. EARTH GRID: -A system grounding electrodes consisting of inter connected connectors buried in the earth to provide a common ground for electrical devices and metallic structures.
5. EARTH MAT:-A grounding system formed by a grid horizontally buried conductor / plate and which serves to dissipate the earth fault current to earth and also as equipment bonding conductor system.

**b) Objectives of earthing:**

The basics of safe grounding are:

1. To design and construct system that is capable to carry current under normal and fault conditions to ground.

2. The earth path shall be capable of handling magnitude and duration of current as per the over current protection of the system without any fire or flash or explosion.
3. Persons in the vicinity of earthed structures and installations shall not be exposed to the dangers of electrical shocks.

**c) General guidelines for earthing:**

An effective grounding system must satisfy the following conditions: -

1. Provide a low impedance path to ground for personnel and equipment.
2. Withstand and dissipate repeated faults and surge currents.
3. Provide ample corrosion allowance to various chemicals to ensure continuous service during life of the equipment being protected.
4. Provide rugged mechanical properties for easy driving of earth electrodes with minimum difficulty.
5. All non-current carrying metal parts associated with installation shall:
   (i) be effectively earthed to a grounding system or mat which will limit the touch and step potential to tolerable values.
   (ii) limit the ground potential rise to tolerable values so as to prevent danger due to transfer of potential through ground, earth wires, cable sheath fences, pipe lines etc.
   (iii) maintain the resistance of the earth connection to such a value as to make operation of the protective device effective.

**d) Statutory stipulations:**

1. All medium voltage equipment shall be earthed by two separate and distinct connections.
2. As far as possible, all earth connections shall be visible for inspection.
3. Each earth system shall be so designed that testing of individual earth electrode shall be possible.
4. Resistance of earth system shall conform to degree of shock protection desired.

**e) Safety precautions for earthing:**

The precautions mentioned below shall be adapted to the extent applicable and possible.

1. Examine earthing devices periodically and always prior to their use.
2. Use only earthing switches or any other special apparatus where provided for earthing.
3. Verify that the circuit is dead by means of discharging rod. The indicator itself shall first be tested on a live circuit or proving unit before and after the verification.
4. Earthing shall be done in such a manner that the persons doing the job are protected by earth connections on both sides of their working zone.
5. All the three phases shall be effectively earthed and short circuited though work may be proceeding on one phase only.
6. In the case of high and extra high voltage the neutral points shall be earthed by not Less than two separate and distinct connections with earth, each having its own electrode at the generating station or substation and may be earthed at any other point provided 'no interference is caused by such earthing.
7. If necessary, the neutral may be earthed through suitable impedance.
8. In cases where direct earthing may prove harmful rather than provide safety (for example, high frequency and main frequency coreless induction furnaces) relaxation may be obtained from the competent authority.
9. No cut-out, link or switch other than a linked switch arranged to operate simultaneously on the Earthed or earthed neutral conductor and the live conductors shall be inserted on any supply System.
10. This however does not include the case of a switch for use in controlling a generator or a transformer or a link for test purposes.

11. Grounding is not likely to reduce the total magnitude of over-voltage produced by lighting or switching surges. It can, however, distribute the voltage between phases and reduce the possibility of excessive voltage stress on the phase-to-ground insulation of a particular phase.
12. The voltage gradient at the surface of the ground may also constitute a danger to life, especially where cattle are concerned. The former risk arises mainly in connection with large electrode systems as at power stations and substation.
13. Earth electrodes other than those used for the earthing of the fence itself, shall not be installed.
14. In proximity to a metal fence to avoid the possibility of the fence becoming live and thus.
15. The materials used for making connections have to be compatible with the earth rod and the copper earthing conductor so that galvanic corrosion is minimized. In all cases, the connections have to be mechanically strong.
16. The cross-sectional area of every protective conductor which does not form part of the supply cable or cable enclosure shall be in any case, not less than2.5 mm2, if mechanical protection is provided and4 mm2, if mechanical protection is not provided.
17. Joints of protective conductors shall be accessible for inspection and testing except m compound-filled or encapsulated joints.
18. No switching device shall is inserted in the protective conductor, but joints which can be disconnected for test purposes by use of a tool may be provided.
19. An auxiliary earth electrode shall be provided electrically independent of all other earthed metal, for example, constructional metalwork, pipes, or metal-sheathed cables. This requirement is considered to be fulfilled if the auxiliary earth electrode is installed at a specified distance from all other earthed metal (value of distance under consideration).
20. The earthing conductor leading to the auxiliary earth electrode shall be isolated to avoid contact with the protective conductor or any of the parts connected thereto or extraneous conductive parts which are, or may be, in contact with them.
21. When the source of energy is privately owned, there shall be no metallic connection with the General public supply unless there has been consultation with the electricity authority concerned.
22. It shall be emphasized that an installation together with its source of energy may not consist entirely of one particular type of system. In such cases, each part of that installation may be required to be treated separately without detriment to other parts of the same installation.
23. The neutral points of each separate electricity system which has to be earthed at the power station or substation.
24. Earthing resistance of earthing rod is changed from 0.3Ω to 0.8Ω between summers to winter.
25. Distance between two earthing pit is 2 X Length of earthing electrode.
26. If ground resistance is high in case of plate earthing (if hard rock), then Pipe earthing shall be used.
27. Resistance between two earthing pit is negligible.
28. Earthing of lightning protection shall not be mixed with power system earthing.
29. Lightning protection earthing shall be 10 time stronger than normal earthing (use copper bus strip instead of wire)
30. Jointing of earthing strip shall be overlap of min 50mm and for earthing wire overlapping shall be min 40mm.
31. Plate Earthing Electrode for copper shall be 600X600X31mm and for Hot dip GI shall be 600X600X63mm.
32. The earth connection shall be joined to the plate at not less than two separate points.
33. Plate electrodes shall be buried such that top edge is at a depth not less than 15m from the surface of the ground. However, the depth at which plates are set shall be such as to ensure that the surrounding soil is always damp.
34. Pipes may be of cast iron of not less than 100mm diameter, 2.5 to 3 m long and 13 mm thick. Such pipes cannot be driven satisfactorily and may, therefore, be more expensive to install than plates for the same effective Area.

35. Pipe electrode shall be buried vertically in the ground as far as practicable below permanent moisture level, but in any case not less than 3 meters below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode.
36. Plate / Pipe Electrode shall be in vertical position.
37. GI/PVC pipe for Watering shall be used of 40mm Diameter, length of 3 meter ( contain hole of 12mm Diameter in Zigzag manner starting from 15cm away from bottom to 2 meter height ).
38. At bottom 150mm layer of Salt and charcoal power shall be installed than Plate shall be installed.
39. Min 120kg of charcoal power and 120kg of salt shall be used for each earth pit.
40. Water pipes shall not be used as consumer earth electrodes.
41. Under fault conditions, the earth electrode is raised to a potential with respect to the general mass of the earth that can be calculated from the prospective fault current and the earth resistance of the electrode. In the soil around the electrode, that may be injurious to telephone and pilot cables, whose cores are substantially at earth potential, owing to the voltage to which the sheaths of such cables are raised.

**f) Earthing of overhead lines:**

All metal supports, all reinforced and pre-stressed cement concrete supports of overhead lines and metallic fittings attached thereto shall be permanently and effectively earthed. For this purpose a continuous earth wire shall be provided and securely fastened to each pole and connected with earth ordinarily at three points in every kilometer, the spacing between the points being as nearly equidistance as possible. Alternatively, each support and the metallic fitting attached thereto shall be efficiently earthed. Metallic bearer wire used for supporting insulated wire of low and medium voltage overhead service lines shall be efficiently earthed or insulated. Each stay wire shall be similarly earthed unless insulator has been placed in it at a height not less than 3.0 meters from the ground.

**g) Earthing and short-circuiting mains:**

1. High voltage mains shall not be worked upon unless they are discharged to earth, after making them dead are earthed, short-circuited with earthing. Short circuiting equipment is adequate to carry possible short circuit currents. All earthing switches wherever installed shall be locked up.
2. If a cable is required to be cut, a steel wedge shall be carefully driven through it at the point where it is to be cut.
3. After testing the cable with DC voltage the cable shall be discharged through 2 mega ohms resistance and not directly owing to dielectric absorption, which is particularly prominent in the DC voltage testing of high voltage cables. The cable shall be discharged for sufficiently long period to prevent rebuilding up of the voltage.
4. 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.
5. Except for the purpose of testing, phasing etc. the earthing and the short-circuiting devices shall remain connected for the duration of the work.

**h) 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, that is, the end of earthing device attached to the conductors of the earthed mains or apparatus shall be removed first and the other end the connected to earth shall be removed last. The conductor shall not be touched after the earthing device has been removed from it.

**i) Testing and record:**

1. All earthing systems belonging to the utility shall in addition, be tested for resistance on dry day during the dry season not less than once every two years.
2. A record of every earth test made & the result thereof shall be kept by the utility for a period of not less than two years after the day of testing.
3. It shall be available to the Electrical Inspector or any officer appointed to assist the Inspector & authorized.

**B. Safety instructions for working on mains and apparatus:**

**a) Inspection of safety equipment:**

All equipment used for working on overhead lines and apparatus shall be surveyed every month by a responsible official and he shall take random checks; on the equipment to satisfy himself that the equipment is in good condition paying special attention to the safety equipment such as safety belt, gloves, ropes used for hoisting etc as per schedule. Any replacement due to wear and tear shall be made immediately. Every authorized person / in charge of a working party before commencing his work shall ensure that all equipment being used are in safe condition and not weakened by deterioration, abrasion etc. He shall not permit the work to be carried out if for any reason he is in doubt that the equipment is unsuitable or deteriorated to the extent that it is likely to cause a hazard.

**b)Safety instructions for working on mains and apparatus up to and including 650 Volts:**

**I. Work on dead mains and apparatus:**

Only Authorized person is authorized to work on live low and medium voltage mains and apparatus, all mains and apparatus to be worked upon shall be isolated from all sources of supply before starting the work, proved dead, earthed and short circuited. For earthing and short-circuiting, only appropriate methods (earthing chains, earthing rods etc.) shall be used. Measures shall be taken against the inadvertent energizing (back charging) of the mains and the apparatus.

**II. Work on live mains and apparatus:**

Only competent, experienced and authorized persons shall work on live mains and apparatus, and such persons shall take all safety measures as may be required under the Electricity Rules 1956. Safety Tags shall be attached on or adjacent to the live apparatus and at the limits of the zone in which work may be carried out. Immediately before starting work, rubber gauntlets, if used, shall be thoroughly examined by authorized person / user to see whether they are in sound condition. Under no circumstances shall a person work with unsound gauntlets, mats, stools, platforms or other accessories, proper testing shall be carried out as per manufacturer guidelines.

**III. Connecting dead mains to live mains:**

When dead mains are connected to live mains, all connections to the live parts shall be made last, and in all cases the phases sequence shall be checked to ensure that only like phases are connected together by testing Phase Sequence tester Rod & Phase Sequence Meter for HT & LT respectively. Before inserting fuses or links in distribution pillar controlling the cable on which a fault has been cleared, each phase shall first be connected through a test switch fuse lower than the value of the load.

**c) Safety instructions for working on mains and apparatus at voltages above 650 Volts:**

1. All high voltage mains and apparatus shall be regarded as live and a source of danger and treated accordingly, unless it is positively known to be dead and earthed.
2. No person shall work on, test or earth mains or apparatus unless covered by a permit to work and after providing the mains dead except for the purpose of connecting the testing apparatus etc. which is specially designed for connecting to the live parts.
3. The operations of proving dead, earthing and short circuiting of any mains shall be carried out only by an authorized person under the instructions of the person in charge of the work.
4. While working on mains, the following precautions shall be taken:
   (i) No person, after receiving a permit to work, shall work on, or in any way interfere with, any mains or conduits containing a live mains except under the personal instructions and supervision, on the site of work, of competent person.
   (ii) When any live main is to be earthed, the procedure prescribed scrupulously followed.
   (iii) The earths and short circuits, specified on the permit to work shall not be removed or interfered with except by authority from the person in charge of the work.

**d) Operation of switches and isolators:**

**I. General:**

No high voltage switch, isolator or earthing switch shall be operated or earth connection attached or removed without the sanction of an authorized person, except in the case of moveable earth connection on high voltage overhead lines, which may be fixed or moved by an authorized person under the direction of the permit to work, which authorizes him to carry out the work. When a switching operation has to be carried out, the authorized person shall convey his instructions to the operating person detailed to carry out the operations. On receipt of the instructions the Operating person shall notify the authorized person of any objections to the carrying out of such instructions, the authorized person shall then decide whether the work is to proceed. The authorized person shall immediately after this, inform the Power System Control of his instructions and the objections if any. The authorized person shall also inform the same receiving station of the operations he is to perform just prior to carrying them out, with objections if any. The procedure for delivering the message and logging them shall be carried out in all cases. The two messages shall be checked by Shift in charge / Shift Officer of Grid / PSC and clearance given for carrying out the work, if in order. On completion the authorized person shall report back to the grid station & perform operations according to the guide lines of Power System Control. While opening isolator confirm that it is not carrying load current. Similarly isolator shall not be closed on load. Isolating switches provided for Generators and synchronous condensers and other rotating machines shall never be opened when connected to any voltage source even when the machine is carrying no load.

**II. Emergency:**

In case of danger to life, switches may be opened without instructions but in no case must a switch be closed (as per PTW guidelines) except with previous written instruction or special permission from an authorized person or when a switch trips on temporary faults, and then only twice in succession.
When any operation is carried out in an emergency in case of grave danger without the permit to work being issued or without emergency authorization or in case of trapping due to temporary faults the grid station from which supply is received shall be informed as soon as possible and the message logged on log sheet & GDR. The number of the message on the log sheet shall be marked in the report of occurrence. Such messages shall also be conveyed immediately to the person authorized by him in this behalf.

**e) Testing of mains and apparatus:**

No person shall apply test voltage to any mains unless he has received a permit to work and has warned all persons working on the mains of the proposed application of the test voltage. If any part, which will thus become alive is exposed, the person in charge of the test shall take due precautions to ensure that the exposed live portion does not constitute danger to any person. It shall also be ensured before the application of test voltage, that no other permit to work has been issued for working on this main.

**I. Authorization for testing:**

When equipment is isolated from the mains supply for the testing, the official responsible may give sanction for the operation of switches, isolators, earthing switches, earth connections etc. and for the application of testing supplies to the isolated section, without reference to him. The person in charge of the testing then becomes wholly responsible for the safety precautions within the isolated sections but no switch or isolator connecting any isolated sections to the main supply system shall be operated without direct sanction of the responsible official except for purpose of obtaining testing supplies.

**II. Devices for proving mains and apparatus dead:**

**i) High voltage indicator rods (Neon tester):**

High voltage neon lamp contact indicator rods are used for proving exposed mains and apparatus dead. Each rod is fitted with an indicating neon bulb, (it shall always be tested before using) which glow, when the contact end of the rod comes in contact with exposed live parts. Each rod is clearly marked for maximum voltage on which it may be safely used and shall not, under any circumstances, be used on higher voltages.

**ii) Use of high voltage indicator rods:**

Contact indicator and phasing rods are provided for phasing and proving exposed mains and apparatus dead. A set consists of two rods connected in series by a length of insulated rods. Both rods are fitted with contact tips and indicating tubes. When the contact tip of one rod is applied to exposed live part and that of the other to earth or other exposed live part provided there is sufficient voltage difference between the two, the indicating tubes shall glow. Each set of rods is normally marked for the maximum voltage on which it can be safely used and shall not, under any circumstances, be used on higher voltages.

**iii) Testing and marking of devices:**

It shall be ensured that all devices for proving high voltage mains and apparatus dead are marked clearly with the maximum voltage for which they are intended and shall be tested periodically as per manufacturer guidelines.

**C. Working on cables:**

**a)Identification of cables to be worked upon:**

A cable shall be identified as that having been proved dead prior to cutting or carrying out any operation which may involve work on or movement of the cable, A neon-contact indicating rod, induction testing set may be used for proving the cable dead. Simply with the help of neon-contact indicating rod cable shall be checked after switched off.

**b) Working on high voltage cable:**

Work on high voltage cables shall be only permitted on receipt of the permit to work. In addition to the precautions taken under the person carrying out such work shall be personally instructed on the spot by an authorized person who shall first satisfy himself that the cable has been made dead isolated and earthed and if possible, the switch controlling the cable drawn from the cubicle and suitable danger boards installed in position

**c) Working on underground cables:**

1. For isolation of cables open at least one set of disconnecting switches or fuses in every source through which the cables can be made alive including leads to the cable of potential transformers and then discharge the cable to earth.
2. Cable route indicators shall be provided and cable route records maintained. It would access the particulars of all underground cables correctly in the vicinity of the faulty cable.
3. Use of sharp edged crowbars or pick axes shall be avoided during excavation while locating the faulty cable or laying new cable.
4. All the cables in the vicinity in the fault area shall be exposed and identified to establish the identification of the faulty cable.
5. Before any high voltage joint of chamber is to be opened in circumstances where it is not desirable to spike the cables or earthing the joint or chambers, the authorized person shall satisfy from cable route record and, if necessary, by approved tests that the joint or chamber is associated with the particular cable which has been made dead and it is safe to work on it.
6. Employees shall not step on live cables even though those are insulated and enclosed in a lead sheath. Tools and materials shall not be rested against the sheath of the cable.

**D. Working on height:**

Before any work is began on any pole or tower of a high voltage overhead line, which is adjacent and parallel to any other high voltage overhead line with conductors “alive” or any pole or tower which supports, more than one set of high voltage conductors “alive” the following special precautions, in addition to the foregoing, shall be taken in every case:

1. The authorized person in charge of the work shall ensure that each workman who is to work on the poles or towers is definitely informed and thoroughly understands on which set of conductors the work is to be carried out.
2. A “red” flag / Caution Tape (or lamp at night) which are available with maintenance crew, shall be displayed on the side of the pole or structure on which the conductors are “alive”.
3. Work shall not be performed on any higher position of tower / line when a line below is energized.

**E. Working on high voltage apparatus and overhead lines:**

Before commencing any work of repairs, alterations, extensions, additions or cleaning of high voltage apparatus and overhead lines the following operations shall be carried out in sequence.

1. The apparatus or cable or transmission line shall be switched out and isolated from all points of supply under the direction of the authorized person.
2. The switches, isolators and control links shall be locked in position by the keys provided for the purpose.
3. Safety Tags shall be placed at all points where apparatus can be made alive.
4. All apparatus shall be discharged to earth and efficiently connected to earth near all points from which supply could be connected to it or between such points and the place of the work. All earthing shall be

done by the approved methods. The earthing leads used for earthing shall be of adequate cross section according to voltage levels to enable passage of the fault current without fusing. Safety Tags shall be removed by an authorized person.

5. Earthing shall also be carried out at the point of work by means of temporary earths on each phase and in no case shall the temporary earths be removed from two phases simultaneously while the work is being carried out.

**F. Working on lower portion of towers carrying live lines:**

Painting and other work on the lower portion of towers or supports carrying live lines and above, the anti-climbing device may be permitted under the permit to work card provided that suitable precautions are taken to ensure that all persons carrying out work are acquainted with the distinctive marks (caution order) that have been placed on the tower and the support. For this purpose all the towers and the supports shall be distinctly marked either by color or by other positive manner above which no operation shall be carried out without making the line dead. Distinctive marking shall be so provided that it is not possible to get nearer than a minimum distance of 6 feet from a live conductor.

**G.Working on deadlines and equipment:**

**a)Grounding of lines and equipment:**

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 shall be short circuited and grounded between the location of work and all possible sources of energy.
2. Conductors to be grounded shall be checked for potential by an approved method before the ground is installed.
3. Temporary grounding cables shall be flexible stranded copper not less than No.10 and shall be equipped with approved clamps at each end.
4. Grounding cables shall 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. Insulated hot-sticks shall be used in making the ground connection to the circuit or apparatus.
6. Grounds shall be placed on all phases even if work is to be carried out on one phase only.
7. For work on the line, ground shall be placed at nearest tower on each side of the point of work, but in no case shall earths be more than six spans apart. As an additional safety measure, if possible, in addition to above grounds, line shall also be grounded on the tower 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 stake driven into the ground. The line shall also be grounded at the nearest line grounding point on either side of the point of work.
9. Where two or more crews are working independently on the same line or equipment, each crew shall properly protect themselves by placing their own temporary grounds.

**b) Line work on poles and towers:**

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 tensions of wires on them, they shall be properly braced or guyed before they are climbed.
3. Linemen shall wear their safety lines while working on the poles and towers.
4. Wire hooks shall not be attached to linemen's belts.
5. Safety straps shall not be placed above the top cross arm when it is at the top of the pole.

**c) Working on lines under adverse weather conditions:**

In the event of the near approach of lightning or thunderstorm all work on overhead lines shall cease immediately.

**H. Working on switching operations:**

1. Every message relating to the switching operations on the high voltage system shall, wherever practicable, be written down. Every such message shall be repeated in full to the sender to ensure that the message has been accurately received.
2. A record of high voltage switching will be entered in station log.
3. All breakers and isolators shall bear lettering or sign boards to indicate the circuit they control.
4. When releasing the electric circuits, breakers or equipment for work on them, the associated breaker and disconnecting switches shall be opened in the following order:
   (i) The breaker will be opened first.
   (ii) The isolator will be opened, but before operating the isolator, it shall be made sure that the breaker is open.
5. After opening isolators and air break switches, check carefully to see that all blades are in full open position.
6. When lines and circuits are taken out of service, the breaker control circuit shall be opened either by operating the opening device or by removing the control circuit fuses.
7. If the circuit is controlled by automatic re-closing breaker, the re-closing mechanism shall be made inoperative.
8. Isolators shall be closed in firm positive manner, using sufficient force to make full contact of blades.
9. Before removing fuses, switches shall be opened if provided. Removing fuses from inductive circuit carrying current without opening the switch is hazardous.

**I. Working in sub stations:**

1. Safety Tags shall be placed on all enclosures of high voltage equipment and wherever necessary warn persons of the presence of high voltage equipment.
2. Gates in switchyard fences and doors to switch gear and other enclosures containing live equipment, or other hazards, shall be kept locked at all times except when Authorized Person entered for working inside.
3. When carrying ladders, pipes, conduits, reinforced rods and other long material in to stations, switchyards, switch gear rooms and other places where there is a danger of touching the live parts, the material shall be held by two men, one at each end, and carried in the hands and not on the shallers.
4. When working in the vicinity of circuit breakers or buses use every precaution to avoid injury from arcing.
5. Area is to be guarded off wherever possible, where men are working on H.T. equipment.

**J. Working on transformer:**

**a) General:**

1. When work is to be carried out on a transformer, both low and high tension breakers and isolators shall be opened. Similarly, during isolation of transformers to which potential transformers are connected, such potential transformers shall be isolated.
2. Before starting any work on a transformer installation, it is important to check carefully for back feed, abnormal voltage or other dangerous conditions. Unusual circuit conditions may exist which require special consideration.
3. Whenever transformers are replaced, the new transformer shall be checked carefully for voltage, polarity and phase sequence before taking into service.
4. Area shall always be cordoned off & Safety tagging shall be done prior to starting the job on transformer.
5. Transformer shall be discharged and grounded from all sides (windings). Neutral grounding of the transformer shall not be treated as grounding.
6. Current transformer secondary shall never to be left open circuited.
7. Take adequate Precautions so that no live parts are exposed.
8. Concerned Installation to be responsible for continuous observance of required provisions.
9. During maintenance, take written work permit before start of work.
10. Ensure use of Personal Protective Equipment and stand on rubber mat while working.
11. Ensure that equipment is off loaded.
12. Ensure that power terminals are discharged to ground before working on them.
13. Ensure that no loose objects/ tools are left inside the terminals box and surrounding it after the completion of work.
14. While Insulation resistance testing, ensure that after testing, winding is discharged to ground and also ensure that testing leads are not loosely connected to winding or touched with bare hands.
15. Display the Danger Mark (Skull and Bone) and High Voltage Installation Symbol in the Transformer Area.
16. While topping up of oil, ensure that there is no spillage. Always put used and oily cloth in designated bins.
17. Ensure firefighting systems are healthy.
18. Used oil to be collected in leak proof containers and the same to be discharged as per the provisions of the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules.
19. Nobody shall smoke in this area.
20. Carry out the Inspection and maintain records.

**b) Working on instrument transformers:**

1. The cases of all instrument transformers shall be grounded.
2. Current transformers secondaries shall never be open circuited when current is flowing in the primary.
3. The secondary circuit of current transformers shall be connected to ground at all times when the transformer is in service.
4. Potential transformers secondaries shall never be shorted.
5. The low voltage winding of potential transformers shall always have one side permanently and effectively grounded.

**c)Working on pole mounted transformer (Distribution transformer):**

1. The work shall be carried out under a permit to work.
2. Before changing or replenishing oil or painting, all exposed live parts of the transformers shall be disconnected.
3. While working on poles that have lightning arresters installed on them, the workman shall avoid touching lightning arresters and lightning arresters jumper.

**d) Power Transformers:**

Following protections shall be provided for Power Transformers

1. Differential protection
2. Restricted Earth Fault Protection
3. Directional Back up O/C and E/F Protection on HV &MV sides
4. Over fluxing Protection
5. Over Load Alarm
6. Buchholz, Pressure Relief Device (PRD)
7. Alarm & Tripping due to Oil and Winding temperatures
8. Emulsifier/Nitrogen/CO2 Flooding System shall be provided as required.

**e) Working on filtration of oil of transformer:**

When carrying out work of filtering of oil on transformers, care shall be exercised that all exposed live conductors are suitably barricaded so that no person and no apparatus such as flexible hose etc. that is being handled comes in contact with the live parts. All such work shall be carried out under the direct supervision of an authorized person.

**K. Working on circuit breakers:**

For isolation purposes it shall be ensured that

1. Disconnecting switches on sides, control switches, relay trip blocking switches and compartments doors are open.
2. Mechanical blocking, wherever necessary, to prevent unauthorized movement of the mechanism is installed.
3. In OCBs trip-free feature shall be blocked.
4. Underrated circuit breakers shall not be used to clear the fault.
5. No breaker shall be operated beyond stipulated operating duty.
6. Before working on the breaker, the operating mechanism shall be de-energized such discharging spring, disconnecting control supply, bringing the Circuit Breaker to test position (where applicable), releasing air/oil pressure etc.

**L. Working on metal clad, switch gear and control panel:**

1. While working on manually operated panel mounted circuit breakers when the operating handle is on the front and the circuit breaker is on the rear of switchgear or on another panel, a danger notice shall be placed on the handle.
2. When the work is to be carried out on the bus bars spouts the following operations shall be carried out.
   (i) The section of bus bars on which the work is to be carried out shall be made dead and shall be isolated from all points of supply.
   (ii) The isolating arrangements and the shutters of live spouts shall be locked so that they cannot be operated.
   (iii) Where duplicate switches in one tank or on load bus bar isolators are installed and is impossible to isolate them from all points of supply, then all switches and selectors that could be closed on the bus bars on which work is to be carried out shall have their mechanism locked in the open position and the closing mechanism shall be made inoperative.
   (iv) The bus bar shall be earthed with approved earthing equipment at a panel other than at which work is to be done and the isolated section of the bus bars.

**M. Working on outdoor structure:**

**a)Bus bars:**

1. In isolating the point of work from supply, care shall be taken to disconnect right points in case of sectionalized, and/or mesh schemes of bus bars.
2. Isolators/switches closing on the section of bus bars on which work is to be carried out shall be locked in open position and the closing mechanism rendered inoperative.
3. While working on the outdoor structure at a height more than 3 meters from the ground level, safety equipment such as safety belts, handling, etc. shall be used.
4. No person shall stand directly below the place of work when the work is in progress in the outdoor structure to avoid any tools or bolts or nuts or clamps etc. falling on their heads.
5. Helmets shall be invariably used while working on the outdoor structures, on the outdoor structures, both by the men stationed at the ground and those on the structures.

**b) Capacitors:**

1. Every capacitor shall be treated as hot until proved otherwise. Capacitors stores energy and are not necessarily dead when disconnected from the line. Once charged, a capacitor may retain its charge for several hours after it has been disconnected.
2. When a capacitor is to be worked on, first open all cutouts or disconnecting devices to the capacitor, then wait for at-least five minutes for the internal resistors to reduce the voltage. Next, using the hot stick (discharge rod), short circuit and ground all terminals of the capacitors. These terminals shall remain short circuited and grounded while work is being done on the capacitor.
3. To bring the capacitor banks back into service, first remove the jumpers with hot sticks, and then close the cutouts.
4. After cutting out capacitor bank, it shall be allowed to discharge through discharge PT for about 10 minutes. The bank shall be grounded with hot stick before commencing the work.

**c) Lightning arrestor:**

1. No work shall be done on the lightning arresters unless it is disconnected from the line circuit and grounded at both the lines and ground terminals.
2. Lighting arresters shall be grounded independently.

**N. Working on storage batteries:**

1. When making electrolyte for storage batteries always pour acid into the water. The reverse method may cause an explosion.
2. Suitable goggles or face shields shall always be worn when making electrolyte. Nitryle hand gloves shall be used during maintenance of battery.
3. Smoking and use of matches or other open flames are not permitted in battery rooms or while inspecting filling, testing or handling batteries.

**O. Working on lines during installation of insulators, stringing of conductors, jumpering and fixing of spacers or vibration dampers:**

**a)Insulators:**

Flashover phenomena on the high voltage outdoor ceramic insulators are a serious threat to safe and uninterrupted operation of the transmission system. Types of Insulators for overhead lines / substation equipment:

1. String insulators (Suspension or Tension) - For Flexible ACSR line conductors and flexible ACSR bus-bars in substations. Generally identical 'cup and pin' insulator units are assembled in series. For higher strength, two / four / six parallel assemblies are used per assembly. Corona rings are necessary.
2. Post insulators for rigid aluminum tubular bus-bar and equipment – mounted on galvanised steel structure. One, two or more identical units of porcelain insulators are bolted with metal flanges.
3. Hollow bushing insulators for wall bushings, Transformer / Reactor bushings, SF6 GIS bushings, CTs, Circuit Breaker chambers etc. Hollow porcelain body with internal and external surface glazing and cemented end flanges. One or more units are assembled with bolted flanges with neoprene rubber gaskets between the porcelain surface and metal flange for sealing. Corona rings are necessary.
4. String insulators are widely used for EHV AC and HVDC transmission lines. The most important requirements of air insulation and porcelain insulators in EHV-AC and HVDC transmission lines and substations are –
   (i) Creepage distance along the surface of insulators
   (ii) Clearances in air

While the creepage distance requirements are based on level of atmospheric pollution and continuous voltage, the clearances depend on most severe transient overvoltage. The values of minimum creepage distances for porcelain insulators of AC equipment varies between 16 mm/KV for clean atmosphere to 25 mm/KV for heavily polluted atmosphere. The values of creepage for HVDC insulators are higher as the continuous application of DC voltage accelerates the tracking process. Creepage of the order of 45-70 mm/KV are used for outdoor insulators in HVDC system.

**b) Line conductor:**

The design of EHV AC and HVDC overhead transmission line conductors is based on the following considerations.

1. Bundled conductors are essential for eliminating corona losses. The corona effect takes place above critical surface tension of 25 KV / cm. By bundling, the surface stress is reduced to about 18 KV/cm by enlarging the radius (of the bundle) thus eliminating corona.
2. The sub-conductors in the bundle are stranded ACSR or AAAC. Vibrations, wear, fatigue, corrosion are the major problems to be guarded against.
3. Size of conductors (cross section area) is decided by resistance, I2R losses, mechanical strength and sag span calculations.
4. Conductor fittings include – Spacers between sub-conductors of the bundle, mid span conductor joint, anchor clamp with jumper connection and vibration dampers.
5. The earth conductor located above the phase conductors provides lightning protection. In some cases fibre-optic cable is placed axially in the earthed ACSR conductor.

**c) Spacers:**

1. The sub-conductors of the bundled conductor are held in position by means of the spacers at regular interval of about 60 m. The sub-conductors experience unequal wind forces, electromagnetic forces and oscillations. The functional requirement of spacers are:
   (i) To hold sub-conductors in desired configuration
   (ii) To prevent mechanical clashing, twisting or touching of conductors
   (iii) To prevent circulating current through the spacers
   (iv) Corona free construction
   (v) To permit axial movement of sub-conductors
   (vi) To permit pitch or yaw movement of sub-conductors at spacer clamps
   (vii) Enhance service life
2. The resistance of a spacer between sub-conductors shall be above 1 Mega-ohm. This is achieved by synthetic rubber bushes. If the spacers are of conducting type, the contact resistance between

conductor and the spacer clamp shall be less than i milliohm so that the joint does not get heated up due to circulating currents.

**d) Vibration and vibration dampers:**

**I. Vibration:** The overhead conductors face various types of vibrations due to reasons like wind pressure / direction of flow, corona effect, snowfall etc. it may be of different frequencies some of which may cause resonance resulting in high amplitude of vibration and failure of conductors due to mechanical failure or flashover.

i) Factors affecting vibration of conductors are:

1. Conductor span / tension
2. Bundle configuration
3. Spacer configuration and spacing
4. Type / configuration of conductors
5. Supporting clamps and assembly
6. Vibration dampers and their location
7. Wind velocity vis-a-vis terrain of overhead line / tower height
8. Trees near the towers
9. Other electrical / electromagnetic phenomena

ii) Significance of vibrations –

1. The sub-conductors in a bundle tend to come closer and touch each other.
2. The clearance between phases is reduced.
3. Vibration causes failure of strands and ultimately failure of conductors.

The mechanical design of conductors, hardwares, towers, spacers etc depend on permissible vibration level.

**II. Vibration Dampers:** The vibrations of conductors are damped by fitting vibration dampers on the conductors. Dampers cause reduction in amplitude in Aeolian vibrations. The Aeolian vibration of conductors is less with the conductors fitted with vibration dampers. A damper provides concentrated mass at a single point on the conductor and absorbs energy in the wave of vibration. For small conductors used in distribution line, simple dampers are provided in the form of wires twisted around the line conductor over a length of about 5 m of either side of insulator support. For conductors of EHV AC / HVDC lines, Stock Bridge dampers are used. They consist of two hollow weights on either side of the central clamp. The two weights are joined together by flexible steel / aluminum cable with a clamp. The clamp is fitted on the line conductor at a distance of 2-5 m from the insulator support on each side. There are two dampers per insulator support and two per insulator span. The damper weight is about 5-15 Kg, overall length 30-65 cm, Dia. of hollow weights 3-5 cm. Spacers used with bundled conductors provide additional damping effect.

**P. High Voltage / Extra High Voltage static capacitor banks:**

AC Power Systems are required to feed active Loads (watt) as well as reactive load (VAr). Majority of loads connected to a typical Power System are Inductive in nature. Hence it is essential for a Power system to meet demand of active (MW) & reactive Power (inductive) at all times by means of generated active & reactive power. Capacitors are very beneficial in power grids. By producing reactive power, they compensate for the reactive power consumption of electrical motors, transformers, etc.

**a) Capacitor bank:** An assembly at one location of capacitors and all necessary accessories, such as switching equipment, protective equipment, control, etc., required for complete operating installation

**I. Types of capacitor banks:**

**i)Externally Fused Capacitor Banks:** These are units with fuses connected externally to the capacitor units. The fuses are intended to disconnect the faulted capacitor unit in a bank, preventing rupture of the capacitor case. The remaining units can continue in service without interruption.

**ii)Internally Fused Capacitor Banks:** In this design, the entire capacitor is constructed with several series–parallel combinations. Usually, the current limiting fuses are used inside the capacitor bank. These fuses are designed to isolate the failed capacitor unit, allowing the continued service of the remaining units.

**iii)Fuseless Capacitor Banks:** In a fuse less capacitor bank, a number of individual capacitor units are connected in series, and the group of units is referred to as a string. If one of the internal series groups of a capacitor unit fails due to a short circuit, the resulting increase in current through the capacitor unit is small.

**b)Installation tests or field tests:** When the capacitor banks are installed in the desired location, certain tests are performed to ensure that the units are connected to the specifications. The following tests are performed before energization of the capacitor banks.

**c)Capacitance Measurement:** A capacitance meter is used to measure the effective capacitance of the bank to determine the accuracy of the connection. The voltage used for this type of test is only a fraction of the rated voltage. A 10% increase in the capacitance indicates a partially failed capacitor unit.

**d)Low Voltage Energization Test:** In this test method, the capacitive reactance is measured by applying a low voltage to the capacitor bank. The applied voltage for this type of test will be of the order of 120V.

**e)High Voltage Insulation Strength Test:** Extreme caution needs to be taken in performing these tests because these are high voltage tests and the capacitor is an energy storing device. The capacitors shall be protected from tank rupture by an appropriate fuse.

**f)Maintenance:** Capacitor banks require very little maintenance because they are static equipment. However, regular inspection of the capacitor units shall include a check of ventilation, fuses, ambient temperature, phase voltages, line currents, and cleaning of the surfaces for removal of dust. Clearance and Grounding After a capacitor bank is de-energized, there will be residual charges in the units. Therefore, wait at least 5 min before approaching it to allow sufficient time for the internal discharge resistors in each capacitor unit to dissipate the stored energy. However, the grounding leads shall be applied to all three phases to short out and ground the capacitor bank. Even after grounding, it is recommended that individual capacitor units be shorted and grounded before personnel come into contact with them to ensure that no stored energy is present. Leaking from Capacitor Units Another mode of failure in the capacitor bank is leaking due to the failure of the cans. When handling the leaking fluid, avoid contact with the skin and take measures to prevent entry into sensitive areas such as eyes. Periodic Inspection, Measurement, and Maintenance The substation and distribution capacitor banks shall be inspected and electrical measurements be made periodically. The frequency of the inspection shall be determined by local conditions such as environmental factors and type of controller used to switch the capacitors on and off. Visual Inspections Visual inspection of the capacitor bank must be conducted for blown capacitor fuses, capacitor unit leaks, bulged cases, discolored cases, and ruptured cases. During such inspection, check the ground for spilled dielectric fluid, dirty insulating surface on the bushings, signs of overheated electrical joints, open switches, and tripped protective devices.

**g )Thermo vision camera:** An infrared camera is very useful for inspecting the substation equipment for overheated joints and surfaces, and records can be maintained for future reference.

**h)Physical Inspection and Measurements:** Physical inspection and measurements shall include loose connections, overheated lead wires, and faulty fuse tubes. Fuses shall be inspected for evidence of overheating or other such damage. The protection devices shall be inspected for proper settings including the position of the current transformer and the potential transformer. The capacitance of the bank shall be measured and compared with the previous measurements.

**Q. Opening or splicing de-energized conductors or over-head ground wires:**

Before separating and / or splicing a conductor or OGW (while under a clearance), at ground level take the following precautions:

1. Bond all conductors together, including OGWs when applicable and bond them to ground as near to the worksite as practicable.
2. Install a ground on the damaged conductor or OGW at each structure from which it is to be lowered. Continuous grounding must be in place until the conductor or OGW is reinstalled.
3. Install a ground rod and bond it to the metallic work platform if in use. Also install ground cables from the ground rod (using a hot stick) to each side of where the conductor or OGW is to be cut or spliced.
4. If an insulated work platform is used, it must be kept clean and dry.
5. Bond any other conductive objects in the work area to the same ground rod if a worker could bridge between them and the conductor or OGW being worked.
6. The use of insulated or bonded conductive work platforms shall be considered and they shall be accessed quickly to minimize the possibility of getting affected by hazardous step, touch, and transferred touch voltages.
7. Bond equipment used to pull and hold tension on the conductor or OGW to a structure ground or a temporary ground rod.
8. All workers shall stay on the equipment or at least 10 feet away from it. When necessary to access or get off the equipment, it shall be done quickly.

**9. Precautions to be taken before separating / splicing a conductor or OGW at an in-span location above ground level from an insulated or un-insulated aerial device:**

10. Short all conductors together including OGW when applicable and bond them to grounds as near the worksite as practicable.
11. Persons on the ground shall stay at least 10 feet away from the vehicle, ground rods, down, guys, etc, during this operation to reduce exposure to hazardous step, touch and transferred touch voltages.
12. Install a jumper or bond (and /or section of conductor) rated for the maximum continuous current to maintain the continuity of the conductor or OGW before cutting. Use a hot stick when installing a jumper to restore continuity to a severed conductor or OGW.
13. Ground switches may be used in conjunction with personal protective grounds. They must not be used as or in place of personal protective grounds.

**R. Safety in handling and disposal of storage batteries:**

**a)Battery handling:**

1. Verify the type of battery being handled (NICAD, Lead Acid, etc.). Storage batteries emit hydrogen and oxygen gas, especially during the last phase of high rate of charging. If contained in a room, these gases can create an explosive atmosphere.
   (i) Lead Acid batteries contain sulfuric acid; a highly corrosive acid.
   (ii) NICAD Batteries contain Cadmium, Cadmium hydroxide, Nickel, Nickel Hydroxide and Potassium Hydroxide in varying proportions. Cadmium and Nickel are listed as carcinogens. Avoid contact with the liquids contained inside NICAD batteries.

(iii) Nickel Metal Hydride Batteries contain Nickel and small amounts of Manganese, Potassium Hydroxide, Lanthanum and Neodymium. Nickel is a listed carcinogen. The liquids contained in these batteries are irritating to the skin. Avoid Contact. Consult the MSDS for more information.

2. Keep the battery location well ventilated / ensure good exhaust system to prevent formation of explosive gases.
3. Do not adjust connections etc. while charging or in the first hour after charging.
4. Never use a naked light to examine the interior of a battery.
5. Do not smoke or use an open flame.
6. Do not use brushes or devices which can short out a battery cell.
7. Ensure and verify there is a Full Body Shower and Eye Wash system in good working condition near the battery bank.
8. When working with or around electrolytes, ensure there is a solution of baking soda and water available to neutralize any spilt acid.
9. When adding electrolyte solution, always pour acid into water. The reverse can cause an explosion.
10. Wear acid proof gloves, sleeves, apron, and goggles when opening battery caps.
11. Use tools with insulated handles / surfaces
12. Keep Lead acid batteries in tray only.
13. Check for acid leakage & prevent spillage.
14. Maintain level in battery between the desired minimum & maximum levels.
15. Inspect all the Connections.

**b)Battery disposal:**

**i) Lead Acid Batteries**

1. When Battery needs replacement, take out the old one & keep it in identified place.
2. Ensure that all old batteries are sold to Authorized dealers only for further recycling purposes.
3. Give back one old battery against every new battery purchased.
4. Keep records of the incoming & outgoing batteries in the Maintenance Department.

**II. Alkaline Batteries:**

1. Identify old battery due for replacement and keep in identified place.
2. Dispose-off batteries to Pollution Control Board approved vendors only for recycle purpose; else, contact the Manufacturer/ Supplier for suitable replacement and disposal. Maintain records for the same.

**S. Testing of High Voltage / Extra High Voltage equipment:**

a) Testing, operation & maintenance of HV/EHV systems & apparatus

As per Rule 65 of Indian Electricity Rule, 1956:

1. Before approval is accorded by the Inspector under rule 63, the manufacturer's test certificates shall, if required, be produced for all the routine tests as required under the relevant Indian Standard.
2. No new HV or EHV apparatus, cable or supply line shall be commissioned unless such apparatus, cable or supply line are subjected to site tests as per relevant code of practice of the Bureau of Indian Standards.
3. No HV of EHV apparatus, cable or supply line which has been kept disconnected, for a period of 6 months or more, from the system for alterations or repair shall be connected to the system until such apparatus, cable or supply line are subjected to the relevant tests as per code of practice of Bureau of Indian Standards.

4. Notwithstanding the provisions of sub-rules (1) to (3) (both inclusive) the Inspector may require certain additional tests to be carried out before charging the installations or subsequently.
5. All apparatus, cables and supply lines shall be maintained in healthy conditions and tests shall be carried out periodically as per the relevant codes of practice of the Bureau of Indian Standards.
6. Records of all tests, trappings, maintenance works and repairs of all equipment, cables and supply lines shall be duly kept in such a way that these records can be compared with earlier ones.
7. It shall be the responsibility of the owner of all HV and EHV installations to maintain and operate the installations in a condition free from danger and as recommended by the manufacturer and/or by the relevant codes of practice of the Bureau of Indian Standards and / or by the Inspector.

b) Protections

As per Rule 64 A (2) of Indian Electricity Rule, 1956, All systems and circuits shall be so protected as to automatically disconnect the supply under abnormal conditions. The following protection shall be provided, namely

1. Over current protection to disconnect the supply automatically if the rated current of the equipment, cable or supply line is exceeded for a time which the equipment, cable or supply line is not designed to withstand.
2. Earth-fault/earth leakage protection to disconnect the supply automatically if the earth fault current exceeds the limit of current for keeping the contact potential within the reasonable values.
3. Gas pressure type protection to given alarm and tripping shall be provided on all transformers of ratings 1000 KVA and above.
4. Transformers of capacity 10 MVA and above shall be protected against incipient faults by differential protection.
5. All generators with rating of 100 KVA and above shall be protected against earth fault/leakage. All generators of rating 1000 KVA and above shall be protected against faults within the generator winding using restricted earth fault protection or differential protection or by both.

**T. Handling of SF6 gas filled equipment:**

a)The main features of SF6 which determine its suitability for use in electrical equipment are :

1. **Physical Properties:**
   (i) SF6 is one of the heaviest known gases with a density about five times the density of air under similar conditions.
   (ii) SF6 shows little change in vapor pressure over a wide temperature range and It is a soft gas in that it is more compressible dynamically than air.
   (iii) The heat transfer coefficient of SF6 is greater than air and its cooling characteristics by convection are about 1.6 times air.

2. **Dielectric strength**: SF6 has very high dielectric strength - about three times that of air at one atmosphere pressure for a given electrode spacing. The dielectric strength increases with increasing pressure; and at three atmospheres, the dielectric strength is roughly equivalent to transformer oil. The heaters for SF6 in circuit breakers are required to keep the gas from liquefying because, as the gas liquifies, the pressure drops, lowering the dielectric strength. The exact dielectric strength, as compared to air, varies with electrical configuration, electrode spacing, and electrode configuration.

3. **Arc Quenching:** SF6 is approximately 100 times more effective than air in quenching spurious arcing. SF6 also has a high thermal heat capacity that can absorb the energy of the arc without much of a temperature rise.

4. **Electrical Arc Breakdown**: Because of the arc-quenching ability of SF6, corona and arcing in SF6 does not occur until way past the voltage level of onset of corona and arcing in air. SF6 will slowly decompose when exposed to continuous corona.

5. **high chemical stability and non-toxicity**: The long experience with SF6 in electrical switchgear and control gear has demonstrated that there are no major problems concerning its use, provided that certain elementary precautions and procedures are established and observed. SF6 is used in closed or sealed pressure systems. The small quantity of SF6 which may leak into the atmosphere does not deplete the ozone layer and currently has a negligible influence on global warming. However, in order to ensure that its contribution remains negligible, it is recommended to avoid any unnecessary release of SF6 into the atmosphere, since this gas is man-made and has a long lifetime. The by-products of SF6 created in switchgear and controlgear by thermal effects (heating, arcing, spark, discharge, etc.) may have toxic properties. However, the real toxicity depends on the concentration in the switchgear and controlgear room and the exposure time. Taking these factors into consideration it is shown that the presence of SF6 does not impose a greater risk to the operator under normal (operating) or abnormal (internal fault, fire) conditions than the other materials used in any other type of switchgear and controlgear (metals, plastics, etc.), provided the procedures in this document are followed.

**b) General characteristics:**

Clean, new SF6 gas has no colour, smell or taste. It is non-combustible, non-toxic and is chemically inert at room temperatures. Precautions for working safely with SF6 are required for the following reasons:

1) SF6 gas is about five times heavier than air and will, if released into the atmosphere in a sufficient quantity, tend to accumulate initially in low-lying areas where there is no natural ventilation and may cause asphyxiation.

2) SF6 decomposes at high temperatures. Decomposition may occur if the gas is heated, for example, by fire external to the equipment and will occur if there is an electric arc, spark or other electrical discharge within it. Some of the decomposition products may have toxic effects, but under normal service conditions in switchgear and controlgear these are contained within a well-controlled and enclosed environment.

3) SF6 gas, when released into the atmosphere, has a relatively long life and contributes to radiative forcing.

**c) Handling:**

I. SF6 is handled in following circumstances:

1. filing of switchgear,
2. maintenance operations,
3. recycling of used gas,
4. decommissioning of SF6-filled equipment.

II. Factors to be taken into account when handling SF6:

1. appropriate gas handling procedures,
2. appropriate gas handling equipment,
3. quantities of contaminants to be expected.

SF6 could present a danger of asphyxiation due to oxygen deficiency if personnel are working, for example, below ground in ducts or trenches. Therefore there is a need to check for SF6 concentration before entry. When maintenance is required, or if gas is inadvertently released into the atmosphere, precautions are needed to ensure the safety of personnel. The SF6 reclaiming ability of any user, will in general, be limited to detecting and treating normal case scenarios. The technology to handle special contamination of SF6 is relatively expensive and requires experience. The user of SF6 may find it too expensive to provide such facilities by himself but, if so, service providers capable of processing such material shall be used.

**d) Storage and transportation:**

**I. Storage:**

New gas is supplied in cylinders. The new gas cylinders shall not be used for storage of used SF6 at any time. However, appropriately labeled cylinders can be used for storage of SF6. Cylinders shall be specially marked to avoid the mix of used gas with new gas. Used SF6 gas can be stored at a safe ratio of 1 kg of SF6 per 1 litre volume by the use of suitably designed simple storage vessels.

**II. Transportation:**

For transport of new SF6, local transport regulations will apply. None of the regulations currently in existence explicitly mentions contaminated SF6, a multilateral agreement has been formed with regard to all non-mentioned gases and gas mixtures. The main criteria for the transport of used contaminated SF6 are the corrosive and toxic characteristics of the contaminants and their concentrations.

**E. Working with SF6:**

**I. General:**

The following situations may arise when working with SF6:

1. working with new SF6 : filling ;
   (i) SF6 filled equipment under normal service conditions: normal leakage;
   (ii) working with used SF6 which may contain decomposition products: maintenance or extension of switchgear and controlgear;
   (iii) abnormal situations : e.g. internal fault or external fire which may provoke opening of the enclosure ;
   (iv) during and immediately after the fault: operator safety ;
   (v) after the fault or external fire: restorative work ;
   (vi) end of life of equipment: recycling, disposal.

Personnel who are in the vicinity of, or approaching SF6 filled equipment or undertaking routine maintenance including the testing of SF6 gas which generally does not require internal access to the SF6 compartments, do not need any protective clothing or equipment. When routine or emergency work involves gaining access to SF6 compartments, unless there is an indication that SF6 decomposition products are present inside an SF6 compartment, work may proceed without the need for protective clothing and equipment. When routine or emergency work involves contact with SF6 decomposition products protective clothing and equipment is necessary.

Maintenance involving internal access to SF6 compartments is likely to be infrequent and some MV equipment may be removed from site for this purpose. On high voltage equipment it is generally not practical to remove equipment from site.

**II. Hygiene:**

When there is any work on equipment which involves contact with SF6 or its decomposition products, the following conditions must be observed:

1. maintain a high standard of personal hygiene;
2. do not eat, drink or smoke
3. avoid wiping the nose, eyes or face other than with clean paper tissues.

**f) Abnormal release:**

Although very unlikely, abnormal releases of SF6 can occur for following reasons:

(i) abnormal leakage;
(ii) internal fault leading to pressure relief or burn-through of enclosure;
(iii) external fire causing damage to enclosure.

**I. Abnormal leakage:**

Abnormal leakage may be indicated by an SF6 alarm, where fitted, and an under pressure detector fitted to the equipment.
In the case of a switching compartment, the characteristic odour of decomposition products may be noticed. (The human nose is sensitive and can detect concentrations well below the limit values). Before work is permitted, it is necessary to ensure that the concentration of SF6 decomposition products in air is at safe levels.

**II. Internal fault:**

Any persons present at the time of an internal fault shall evacuate the area immediately, irrespective whether SF6 is known or believed to have been released. Before entering into the area it is necessary to ensure that the concentration of decomposition product remains at a safe level. Personnel working under the supervision of a suitably authorized person and wearing protective clothing, and including overalls, full face mask respirator, boots and gloves, may carry out the following:

1. Approach the equipment to perform essential operational procedures (if any).
2. Approach the equipment after the leakage has stopped to remove any decomposition products, gas remaining in the equipment and gas that may have accumulated in low lying areas. The portable gas extraction equipment with disposable filter, disposable cleaning materials and approved vacuum cleaner shall be used for this purpose. An air blower may be used to disperse accumulations of gas. If polluted parts of equipment are not treated on site, they shall then be wrapped and sealed in polythene, labeled and transported to a suitable location for removal of gas and any decomposition products.

**III. External fire:**

SF6 gas can be released through:

1. overpressure in the enclosure,
2. Burn-through of organic material.

As SF6 is non-flammable it cannot feed the fire and indeed could have an extinguishing effect. After release, SF6 would be rapidly dissipated by convection and shall therefore not be exposed to direct heat for long enough for further significant decomposition to occur. The risk of personal exposure is expected to be extremely low, however the same precautions shall be taken before entering the area as for internal fault.

**g) Risks involved with SF6 Toxicity:**

SF6 is odorless, colorless, tasteless, and nontoxic in its pure state. It can, however, exclude oxygen and cause suffocation. If the normal oxygen content of air is reduced from 21 percent to less than 13 percent, suffocation can occur without warning. Recommendation: Equipment tanks shall be purged out after opening.

## CHAPTER 76: SAFETY IN SUB-STATION, SWITCHYARD AND SWITCHBOARD

### A. General:

1. These areas shall be accessible only to authorized persons and notice to be displayed for entry restrictions. Also Danger boards, as per IS-2551, to be affixed as per IE Rule 35. Shock Treatment chart to be displayed and authorized persons shall be trained in First Aid, Artificial Respiration and CPR.
2. No person shall work within minimum working distance from the exposed live mains and apparatus. The minimum working distance depends upon the actual voltages. Exposed live equipment in the vicinity shall be guarded off so that the persons are working on the released equipment in service. The guarding shall be done in such a way that it does not hinder the movement of the maintenance personnel.
3. All barriers, shutters etc. of high voltage equipment must always be kept locked except when required for carrying out work under a permit to work (Safety Tagging) wherever possible. Keys controlling locks, except those in the possession of specified officials, shall be kept in safer place in control room. The controlling / movement of keys shall only be retained by authorized persons / site in-charges.

### B. Safe working clearance:

Minimum clearance to be maintained in air between the live part of the equipment on one hand and earth or other piece of equipment or conductor on which it is necessary to carry out the work, on the other.

I. As per Indian Electricity Rule 114 (3) for Isolation and fixing of transformer, switchgear etc. is applicable in other installations as well:-

Adequate working space and means of access, clear of obstruction and free from danger, shall so far as circumstances permit, be provided for all apparatuses that have to be worked or attended to and all handles intended to be operated shall be conveniently placed for that purpose.

II.As per Indian Electricity Rule 64 (2) (a), the following provisions shall be observed where energy at high or extra-high voltage is supplied, converted, transformed or used: -

1. Clearances as per Indian Standard Code shall be provided for electrical apparatus so that sufficient space is available for easy operation and maintenance without any hazard to the operating and maintenance personnel working near the equipment and for ensuring adequate ventilation.

2. The following Minimum safe working clearance shall be maintained for the bare conductors or live parts of any apparatus in outdoor sub-stations, excluding overhead lines of HV and EHV installations:

| Sl. No. | Highest system voltage (KV) | Safe working clearance (metres) |
|---|---|---|
| 1 | 12 | 2.6 |
| 2 | 36 | 2.8 |
| 3 | 72.5 | 3.1 |
| 4 | 145 | 3.7 |
| 5 | 245 | 4.3 |
| 6 | 420 | 6.4 |
| 7 | 800 | 10.3 |

(i) The values are valid for altitude not exceeding 1000 m. A correction factor 1.25 % per 100 m is to be applied for increasing the clearance for altitude more 1000 m and up to 3000 m.

(ii) The above safety working clearances are based on an insulation height of 2.44 m which is the height of lowest point on the insulator, where it meets the earthed metal, from the ground.

(iii) The Highest System Voltage is defined as the highest rms phase to phase voltage which occurs under normal operating conditions at any time and at any point of the system.

III. The following minimum clearances shall be maintained for bare conductors or live parts of any apparatus in out-door substations, excluding overhead lines of HVDC installations:

| Sl no. | DC Voltage (KV) | Pole to Earth Clearance (Metres) | Ground Clearance (Metres) |
|---|---|---|---|
| 1 | 100 | 1.17 | 4.55 |
| 2 | 200 | 1.8 | 5.65 |
| 3 | 300 | 2.45 | 6.75 |
| 4 | 400 | 3.04 | 8.00 |
| 5 | 500 | 3.65 | 9.00 |
| 6 | 600 | 3.98 | 10.1 |
| 7 | 800 | 5.3 | 11.2 |

1. The above ground clearances are not applicable to equipment that are housed within fence or a building and where access is prevented under energized condition through a suitable safety interlocking scheme.
2. The above "pole to earth" clearances are for conductor structure electrode configuration using gap factor K equal to 1.35.
3. It is recognized that within a substation many different types of electrode configurations shall be there with different values of K, therefore, the above clearance shall be modified based upon the values of gap factor for a particular electrode configuration subjected to the minimum ground clearance.
4. Clearance shall be provided for electrical apparatus so that sufficient space is available for easy operation and maintenance without any hazard to the operating and maintenance personnel working near the equipment and for ensuring adequate ventilation.

IV. As per Indian Electricity Rule 51(1)(c), Provisions applicable to MV, HV or EHV installations :-

i)Every switchboard shall comply with the following provisions:

1. A clear space of not less than 1 metre in width shall be provided in front of the switchboard;

2. If there are any attachments or bare connections at the back of the switchboard, the space, if any, behind the switchboard shall be either less than 20 centimetres or more than 75 centimetres in width, measured from the farthest outstanding part of any attachment or conductor;

3. If the space behind the switchboard exceeds 75 centimetres in width, there shall be a passage-way from either end of the switchboard clear to a height of 1.8 metres.

V. Safe clearance for overhead lines

i) As per Indian Electricity Rule 77, Clearance above ground of the lowest conductor of overhead lines:

1. No conductor of an overhead line, including service lines, erected across a street shall at any point thereof be at a height of less than –

(i) For lines of voltage not exceeding 650 Volts: 5.8 metres

(ii) For lines of voltage exceeding 650 Volts but not exceeding 33 KV: 6.1 metres

ii) No conductor of an overhead line, including service lines, erected along any street shall at any point thereof be at a height less than –

1. For lines of voltage not exceeding 650 Volts: 5.5 metres
2. For lines of voltage exceeding 650 Volts but not exceeding 33 KV: 5.8 metres

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

1. For lines of voltage up to and including 11 KV, if bare: 4.6 metres
2. For lines of voltage up to and including 11 KV, if insulated: 4.0 metres
3. For lines of voltage exceeding 11 KV but not exceeding 33 KV: 5.2 metres

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

VI. As per Regulation 58 (5) of CEA (Measures relating to safety and electric supply) Regulations, 2010, For HVDC lines, the clearance above ground shall not be less than as mentioned below:

| Sl. No. | DC Voltage (KV) | Ground clearance (Metres) |
|---|---|---|
| 1 | 100 | 6.1 |
| 2 | 200 | 7.3 |
| 3 | 300 | 8.5 |
| 4 | 400 | 9.4 |
| 5 | 500 | 10.6 |
| 6 | 600 | 11.8 |
| 7 | 800 | 13.9 |

VII. As per Indian Electricity Rule 87, Minimum Clearances (in meters) between lines crossing each other

| Sl 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 line of voltage exceeding 33 KV crosses over another line of 250 V and above voltage or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the line of voltage exceeding 33 KV and the topmost conductor of the overhead line crossing underneath the line of voltage exceeding 33 KV and the clearances as stipulated in Regulation 58 from the topmost surface of the road maintained.

VIII. As per Regulation 69 (V) of CEA (Measures relating to safety and electric supply) Regulations, 2010, Minimum Clearances (in meters) between AC and DC lines crossing each other

| Sl. No. | System Voltage AC/DC | 100 KV DC | 200 KV DC | 300 KV DC | 400 KV DC | 500 KV DC | 600 KV DC |
|---|---|---|---|---|---|---|---|
| 1 | Low & Medium AC | 3.05 | 4.71 | 5.32 | 6.04 | 6.79 | 7.54 |
| 2 | 11-66 KV AC | 3.05 | 4.71 | 5.32 | 6.04 | 6.79 | 7.54 |
| 3 | 110-132 KV AC | 3.05 | 4.71 | 5.32 | 6.04 | 6.79 | 7.54 |
| 4 | 220 KV AC | 4.58 | 4.71 | 5.32 | 6.04 | 6.79 | 7.54 |
| 5 | 200 KV DC | 4.71 | 4.71 | 5.32 | 6.04 | 6.79 | 7.54 |
| 6 | 300 KV AC | 5.32 | 5.32 | 5.32 | 6.04 | 6.79 | 7.54 |
| 7 | 400 KV AC | 5.49 | 5.49 | 5.49 | 6.04 | 6.79 | 7.54 |
| 8 | 400 KV DC | 6.04 | 6.04 | 6.04 | 6.04 | 6.79 | 7.54 |
| 9 | 500 KV DC | 6.79 | 6.79 | 6.79 | 6.79 | 6.79 | 7.54 |
| 10 | 600 KV DC | 7.54 | 7.54 | 7.54 | 7.54 | 7.54 | 7.54 |
| 11 | 800 KV DC | 7.94 | 7.94 | 7.94 | 7.94 | 7.94 | 7.94 |

IX. As per Indian Electricity Rule 79, Clearance From building of lines of voltage and service lines not exceeding 650 Volt

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

1. for any flat roof, open balcony, verandah roof and lean-to-roof-

(i) when the line passes above the building a vertical clearance of 2.50 metres from the highest point, and

(ii) when the line passes adjacent to the building a horizontal clearance of 1.20 metres from the nearest point

2. for pitched roof-

(i) when the line passes above the building a vertical clearance of 2.50 metres immediately under the line, and
(ii) when the line passes adjacent to the building a horizontal clearance of 1.20 metres
(iii) Any conductor so situated as to have a clearance less than that specified above shall be adequately insulated and shall be attached at suitable intervals to a bare earthed bearer wire having a breaking strength of not less than 350 kg.
(iv) The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

X. As per Indian Electricity Rule 80, Clearance From building of lines of voltage exceeding 650 Volt
i) Where an overhead line of voltage exceeding 650 Volts 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 –

1. For lines of voltage exceeding 650 Volts up to and including 33 KV: 3.7 metres
2. For lines of voltage exceeding 33 KV: 3.7 metres plus 0.30 metres for every additional 33 KV or part thereof

ii) 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 –

1. For lines of voltages exceeding 650 volts up to and including11KV: 1.2 metres
2. For lines of voltages exceeding 11 KV and up to and including 33KV: 2.0 metres
3. For lines of voltages exceeding 33 KV: 2.0 metres plus 0.3 metres for every additional 33 KV or part thereof

[For the purpose of this rule, expression 'building' shall be deemed to include any structure, whether permanent or temporary]

XI. As per Regulation 61 (4) of CEA (Measures relating to safety and electric supply) Regulations, 2010,
For HVDC systems, vertical clearance and horizontal clearance, on the basis of maximum deflection due to wind pressure, from building shall be maintained as follows:

| Sl. No. | DC Voltage (KV) | Vertical clearance (Metres) | Horizontal clearance (Metres) |
|---|---|---|---|
| 1 | 100 | 4.6 | 2.9 |
| 2 | 200 | 5.8 | 4.1 |
| 3 | 300 | 7.0 | 5.3 |
| 4 | 400 | 7.9 | 6.2 |
| 5 | 500 | 9.1 | 7.4 |
| 6 | 600 | 10.3 | 8.6 |
| 7 | 800 | 12.4 | 10.7 |

**C. Guarding of live apparatus:**

All live parts shall be so protected or enclosed as to prevent persons accidentally coming into contact with them and to prevent danger from arcs, short circuits, fire, water, gas or oil. Following fundamental rules have to be followed:

1. Barricade / fence the entire area and prevent unauthorized entry.
2. The entry doors of Switchyard, Transformer yard, Substations, Control Rooms, MCCs and other regulating panels, Cable Cellars etc. be prominently marked for 'Unauthorized Entry Prohibited' and they shall preferably be locked.
3. Panel doors to remain closed with interlock to prevent opening while the system / circuit is ON.

4. Panels / cubicles to be clearly marked for its nomenclature, both at front & backside.
5. No one is allowed to open the front or backside of a panel without written clearance / Permit.

Besides static equipment, guidelines have been given vide Sec.21 of Factories Act, 1948, for rotating machines, wherein it has been stated that – Every part of an electric generator, a motor or rotary converter; every part of transmission machinery and every dangerous part of any other machinery shall be securely fenced by safe guards of substantial construction which shall be constantly maintained and kept in position while the parts of machinery they are fencing are in motion or in use. In this connection IP Standards (International Protection Code) may also be referred. It denotes classification of degrees of protection provided by housing for electrical equipment with rated voltage not exceeding 72.5 KV. They specify the following –

1. Protection of persons
2. Protection of electrical equipment against penetration of solid matter, including dust
3. Protection of electrical equipment against the harmful effects of water

IP code consists of the letters "IP" and two digits.

1st digit (1-6) denotes protection against infiltration of impurities

1. 50.0 mm and above
2. 12.5 mm and above
3. 2.5 mm and above
4. 1.0 mm and above
5. *Protection against dust
6. Dust proof *Ingress of dust not totally eliminated. But, dust may not penetrate the enclosure to an extent that may affect functioning of the device or safety.

2nd digit (1-9) stands for protection against water

1. Vertical dripping of water
2. Dripping with ± 150 tilted enclosure
3. Water spray at ± 600 inclination
4. Water splash from any direction
5. Water jet (any direction)
6. -do- High power
7. Intermittent submersion in water
8. Continuous submersion in water
9. High pressure water and steam jet cleaning

**D. Operation on live apparatus:**

The operation of power station requires that its staff is trained and well versed with all necessary technical as well as basic trouble shooting knowledge.

**E. General provisions relating to maintenance:**

NO MAINTENANCE ACTIVITY CAN BE STARTED UNLESS A WRITTEN WORK PERMIT / LINE CLEARANCE HAS BEEN ISSUED BY AN AUTHORISED PERSON IN THE ORGANISATION AND LOCK OUT TAG OUT (LOTO) PROVISIONS COMPLIED WITH.

**a)Safe Clearance Provisions**: Safe Clearance provides LOTO directions for the safe blocking, tagging, and grounding of electrical switching and controlling devices to clear lines and equipment for the safe accomplishment of work in the de-energized condition.

**b) Preparation Responsibility**: A LOTO procedure will be developed by certified individuals authorized to do so. **Standardization/Strength**: LOTO devices shall be standardized within each facility based on at least one of the following ways: colour, shape, or size. They shall be securely fixed to prevent displacement / unauthorized removal.

**c)Tag Recognition**: In the process of LOTO tags defining the hazard and the control measure to be used must be filled in, including the names of the individual responsible for the tag and the functional manager. The tags must warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: DO NOT START / DO NOT OPEN / DO NOT CLOSE/ DO NOT ENERGIZE / DO NOT OPERATE. The Maintenance Planning is an important part in Maintenance Management System. The Central Electricity Authority has recommended in their regulation 2010 the Maintenance planning (vide article 5, 6) as well as Maintenance Management System (Article 24-32). These recommendations shall be followed as guidelines to decide the maintenance strategies at different units / power stations.

**d) Maintenance Planning**:

1. The Regional Power Committees shall, before the commencement of the financial year, prepare an annual maintenance plan for the generating stations and the inter-State transmission system in their respective regions keeping in view the demand pattern and maintenance schedule of the generating units and diversity in demand of the States.
2. The Regional Power Committees shall co-ordinate the annual maintenance plan for Inter-Regional transmission system.
3. The Regional Power Committees shall review and revise the coordinated generation and transmission system maintenance plan in their monthly operating Committee meetings.
4. The State Load Despatch Centre shall in consultation with the concerned transmission licensee, coordinate the annual maintenance plan of Intra-State transmission system taking into account the annual maintenance plan of generating units and inter-state transmission system decided by the Regional Power Committee.
5. The State Load Despatch Centre shall also review and coordinate the maintenance plan of intra-state transmission system for the next month, taking into account the monthly maintenance plan of generating units and inter-state transmission system prepared by the Regional Power Committee for the next month.
6. The generating company or transmission licensee shall, before actual shut down, obtain the approval of the Appropriate Load Despatch Centre.

**e) Coordination in Operations**:

1. No Entity shall introduce or take out the element of the grid without the concurrence of the Appropriate Load Despatch Centre except in case of imminent risk of safety of plant and personnel in which case it must intimate Appropriate Load Despatch Centre giving reasons therefore.
2. The Appropriate Load Despatch Centre shall inform all affected parties of the outage.

**f) Maintenance Management System:**

**Maintenance schedules**:

1. Entities shall identify critical equipment and as far as possible, practice condition based maintenance for such equipment in place of traditional time based maintenance.
2. In case of time based maintenance, the periodicity of maintenance of lines shall be fixed based on whether they are passing through normal area or polluted area or coastal area and the transmission lines and sub-stations in polluted or coastal areas shall be maintained more frequently.
3. The maintenance of lines passing through and sub-stations located in such areas shall be completed once before onset of winter so as to minimize tripping under conditions of fog or due to salt deposit on insulator discs in coastal areas and once before onset of summer.

4. Maintenance and cleaning of various equipment fittings, accessories, primary instruments and sensors shall be carried out when they are de-energized during the shut-down of main equipment so as to minimise shutdown time.
5. Where defects are observed through condition monitoring or during patrolling and inspection, the maintenance work on various items of equipment may be advanced depending on the condition of the equipment.

**g)Use of diagnostic techniques for condition monitoring of equipment**: The diagnostic methods of maintenance shall be preferred over traditional time based maintenance. For purpose of this regulation, devices or methods specified in the Schedule shall be used.

**h) Thermovision scanning**: The Thermo-vision scanning for hot spots on all overhead lines and sub-station equipment at voltage level of 220 kV and above shall be carried out at least once a year and necessary remedial measures shall be taken where hot spots are detected.

**i) Failure analysis**:

1. All failures of equipment and tower collapse shall be analyzed by the Entity to avoid recurrence and a copy of the report shall be submitted to the Regional Power Committee and the Authority.
2. The Authority may appoint a group of experts for investigation and analysis and the representatives of manufacturers may be invited to participate in such analysis.
3. All relevant data which may help the group of experts in analyzing the failures shall be furnished by the respective Entities.
4. The recommendations of the group of experts shall be submitted to the Authority and the recommendations accepted by the Authority shall be implemented and circulated to all within the organization and to other concerned organizations to prevent recurrence of similar failures.

**j)Inventory control and spare part management**:

1. The required spare parts shall be kept in stock, to ensure speedy the maintenance of the equipment.
2. Computerized materials management system shall be developed by the Entities to optimize inventory.

**k)Maintenance Audit**:

1. An internal committee may be established by the Entities to verify whether actual maintenance works are carried out at site in compliance of the procedures and the policy of the transmission company.
2. The observations of the Committee shall be put up to the management of the Entity for perusal and taking corrective action, if any.

**l)Residual life assessment**: The residual life assessment shall be carried out for all major equipments including transformers, reactors, breakers, as envisaged by the relevant standards specified by the Bureau of Indian Standards, manufacturer's instruction or industry best practices and suitable remedial action for breach of the same shall be taken by the management of the Entity.

**m)Disaster management**:

1. The maintenance staff shall be trained in disaster management and a detailed procedure for the same shall be developed by the Entity and displayed prominently.
2. This detailed procedure shall be reviewed periodically and also based on mock exercises carried out by the Entity.

3. The maintenance staff shall be trained in emergency restoration procedures for managing major failures and breakdowns.
4. The equipment including vehicles, diesel generating sets and firefighting equipment and Emergency Restoration System for transmission lines shall be kept available at sub-station or at appropriate location for disaster management.

**n)Maintenance records**: The records of all maintenance carried out for each equipment shall be kept in the table and formats in electronic form and hard copy and the next due date for maintenance of each item of work shall be clearly marked in such tables and formats.

**o)The Devises and Methods for Condition Based Monitoring of Equipment**:

1. Hot line puncture detection of insulators
2. Vibration measurement of the line
3. Pollution measurement of the equipment
4. Dissolved Gas Analysis of Transformer oil
5. Frequency response analysis of transformers/reactors
6. Tan d and capacitance measurement
7. Circuit breaker operational analyzer
8. Dynamic contact resistance measurements of breakers
9. Third harmonic resistive current measurements of surge arresters
10. Recovery voltage measurements of transformers/reactors
11. Vibration measurements of the reactors
12. Steady state and dynamic testing of protective relays
13. Signature Analysis
14. Partial Discharge measurement for transformers/Gas insulated Switchgear
15. Static resistance meter for circuit breakers, isolators, bus bar joint, earth switches etc.
16. Ground tester for measurement of resistivity of soil and ground resistance
17. Battery impedance test equipment
18. Insulator tester
19. SF6 gas leakage detector and dew point
20. Power quality Analyzer
21. Fibre optic cable testing devices

**F. Working in areas containing exposed live conductors:**

1. Working space around electrical enclosures or equipment shall be adequate for conducting all anticipated maintenance and operations safety, including sufficient space to ensure safety of personnel working during emergency conditions and workers rescuing injured personnel.
2. Isolated the system / equipment from all other points from which it is possible for the system / equipment to become alive (e.g. voltage and auxiliary transformers, common neutral earthling equipment).
3. Locking of all enclosures leading into live section from the work area to avoid wrong or unauthorized accesses to live parts.
4. Locking, tagging of circuit breaker, isolators, control handles and safety devices wherever such arrangements exist.
5. The section de-energized for working shall be that section required for execution of the work and shall be defined by use of barriers, screens, danger notices, etc. in order to maintain specified clearances.
6. For bare conductors or live parts of any apparatus in outdoor substations, excluding overhead lines of HV & EHV installations, the minimum safety working clearance must be maintained.

7. A distance of 300mm (12") shall also be maintained form that portion of the insulators supporting exposed High Voltage conductors which is outside the appropriate safety distance from the conductors.
8. Maintain the clearances specified above while carrying materials, tools, etc.
9. Authorized person shall monitor movement and erection.

**G. Demarcation of work areas:**

a)The Work area shall be clearly defined and, where necessary, protected physically to prevent danger to persons in the work area from system hazards of adjacent plant and / or apparatus. It is essential that persons are alerted to avoid entering any other area where there is danger from the system. The working area shall be so defined that persons approaching it can recognise it is a safe working area. The major work areas shall include –

1. Power House including Generators, Generator Transformers (GTs), Station Transformers (STs), Unit Transformers (UTs) and associated switchgears etc.
2. Switchyard / substations include Transmission Towers, Overhead conductors, Breakers, Isolators, CTs, PTs, Surge suppressors etc.
3. Other utilities e.g. Pump Houses, Lighting / Emergency lighting, battery banks, Air conditioning, Fire Protection systems, earthing system, DG sets etc.

b)Each major area shall be further divided into sub areas and qualified competent persons shall be authorized for operation and maintenance of plant & equipment in specified areas. Each work area shall be clearly identified and relevant statutory provisions shall be complied with e.g.

1. Danger Boards to be displayed at entry point as well as on each installation.
2. Entry Restriction to be displayed at the entrance. Gates to be closed, wherever unmanned.
3. List of authorized persons shall be displayed at work site.
4. Type of Hazards / Risks to be assessed and displayed for general awareness.
5. Shock Treatment Charts to be displayed with list of trained persons.
6. Safety instructions to be displayed at work site.
7. Common safety appliances (Rubber mat / hand-gloves, Discharge rod etc) shall be available at work place.
8. Emergency telephone nos. to be displayed at prominent locations.

**H. Working on remotely controlled and automatically controlled equipment:**

The committee for updating the best practices in Transmission lines in the country recommends that – All EHV Circuit Breakers are controlled and synchronized from switchyard Control Room. All Isolators have remote operation control from Control Room as well as local operation control. The Earth Switches can be operated locally only. Isolators and associated earth switches are provided with electrical as well as constructional mechanical interlocks. Danger may occur to persons working on or testing plant and apparatus which has automatic or remote control, if the same control has not been isolated.

**a)Safety measures for working on remotely controlled and automatically controlled equipment:**

1. Precautions shall be taken to achieve safety from the system by isolating the automatic / remote control as well as local control feature.
2. Such facilities (features) shall be properly isolated and locked till the work is completed.
3. If it is required to restore the automatic / remote control feature for the purpose of testing, a special permit shall be issued for restoration of power for testing.
4. Such test procedures shall be approved before issuing special permit.
5. Only an authorized person or a competent person under personal supervision of an authorized person

shall work on or make any adjustment to the controlling features of plant and apparatus under operating condition. Before commencing such work consultation must take place between the authorized person, controlling authority and Safety.

**I. Working on equipment operated by or containing compressed air:**

a) Any equipment when operated by compressed air or containing compressed air resembles to a pressure vessel and hence all precautionary measures relevant to pressure vessels shall be ensured while working on such equipment. However, for routine Inspection & Maintenance, the following points shall be checked and recorded.

1. Check air pressure in the chamber (ensure the Pressure Gauge is calibrated)
2. Ensure compressors are in good condition (check noise, vibration, temperature etc)
3. The standby compressor also to be tested for its healthiness

b) CEA (Technical standards for electrical plants and electric lines) Regulations, 2010 states the following:

1. Compressed air system comprising of instrument air and service air shall be provided to cater to the requirement for operation of various pneumatically operated drives and general purpose cleaning and maintenance services.
2. Air dryers shall be provided for instrument air to achieve desired dryness.
3. At least one no. Compressor shall be provided as stand-by.

c) Regarding High Pressure and Low Pressure compressed air, the regulation also maintains that-

1. High Pressure (HP) compressed air system shall be provided to meet the requirement of turbine governing system and MIV. The pressure of HP air compressor shall be 1.1 times the governor working pressure. However, the HP compressed air system shall not be required in case high pressure N2 system has been provided for governing system and MIV.
2. Low Pressure (LP) compressed air system shall be provided to meet the requirement of inflatable rubber seal of shaft glands, operation of pneumatic tools, cleaning, generator braking and jacking, boosting pressure in the fire protection hydro-pneumatic tank, pneumatic detection line for the operation of deluge valve provided for the generator transformer etc.
3. A separate compressed air system, wherever required, shall be provided to supply the compressed air for depressing the water level in the draft tube below the runner to run the machine in synchronous condenser operation mode.

d) For maintenance work, system depressurization must be ensured and locked at source. Only authorized persons or competent persons under personal supervision of an authorized person can take up such maintenance work against work permit.

**J. Working on circuit breakers, transformers, isolators, surge arresters, instrument transformers, storage tanks etc:**

The Committee for updating the best practices in Transmission lines in the country, after examination of various Indian and International standards, standardization committee reports and engineering studies, recommended the following parameters.

1. Only SF6 Circuit Breakers may be used at EHV levels. At 400 kV level the circuit breakers are to be provided with closing resistors, if used for switching the line longer than 200 km.
2. The Instrument transformers may be live or dead tank oil insulated type. In future novelle sensors may also be used.
3. The isolators may be generally Horizontal center break type, however double break isolators may also be used depending on layout requirement. The Isolators are to be provided with motor operated operating mechanism.
4. The surge arresters to be used are only of metal oxide gapless type.
5. Shunt reactors to be used are of oil insulated, iron or air core type with ONAN cooling.
6. Inter-connecting transformers shall be provided with On Load Tap Changer and with ONAN/ONAF/OFAF cooling.

7. The transformer may be single phase or three phase depending upon the considerations of transportation constraints or size of the transformers. In case of single phase transformer arrangement, one single phase transformer shall also be procured as spare and kept connected to the system. The switching arrangement of this transformer shall be so designed that it can be connected to any of the phases, whenever required.
8. All equipment are to conform to the type test and routine tested as per relevant standards.

**K. Handling failed SF6 circuit breaker:**

Toxic decomposition products are formed when SF6 gas is subjected to an electric arc. The decomposition products are metal fluorides and form a white or tan powder. Toxic gases are also formed which have the characteristic smell of rotten eggs. Therefore, Faulted SF6 gas can cause nausea and minor irritation of the eyes and upper respiratory tract. Normally, faulted SF6 gas so foul smells, no one can stand exposure long enough at a concentration high enough to cause permanent damage. Solid arc products are toxic and are a white or off-white, ash like powder. Contact with the skin may cause an irritation or possible painful fluoride burn.
Normal circuit breaker operation produces small quantities of arc products during current interruption which normally recombine to SF6. Arc products which do not recombine, or which combine with any oxygen or moisture present, are normally removed by the molecular sieve filter material within the circuit breaker.

**Recommendations:**

1. Equipment tanks shall be purged out after opening.
2. Do not breathe the vapors remaining in a circuit breaker where arcing or corona discharges have occurred in the gas.
3. Evacuate the faulted SF6 gas from the circuit breaker / other equipment and flush with fresh air before working on the circuit breaker.
4. If solid arc products come in contact with the skin, wash immediately with a large amount of water.
5. All materials used in the cleanup operation for large quantities of SF6 arc products shall be placed in a drum and disposed of as hazardous waste.
6. Use special clothing and safety appliances as detailed below.

**Use of PPE:**

Coveralls – Coveralls must be worn when removing solid arc products. Coveralls are not required after all solid arc products are cleaned up. Disposable coveralls are recommended for use when removing solid arc products; however, regular coveralls can be worn if disposable ones are not available, provided they are washed at the end of each day.
Hoods – Hoods must be worn when removing solid arc products from inside a faulted dead-tank circuit breaker. Gloves – Gloves must be worn when solid arc products are hah-died. Inexpensive, disposable gloves are recommended. Non-disposable gloves must be washed in water and allowed to drip-dry after use.
Boots – Slip-on boots, non-disposable or plastic disposable, must be worn by employees who enter eternally faulted dead-tank circuit breakers. Slip-on boots are not required after the removal of solid arc products and vacuuming. Non disposable boots must be washed in water and dried after use.
Safety Glasses – Safety glasses are recommended when handling solid arc products if a full face respirator is not worn.
Respirator – A cartridge, dust-type respirator is required when entering an internally faulted dead-tank circuit breaker. The respirator will remove solid arc products from air breathed, but it does not supply oxygen so it must only be used when there is sufficient oxygen to support life. The filter and cartridge shall be changed when an odor is sensed through the respirator. The use of respirators is optional for work on circuit breakers whose interrupter units are not large enough for a man to enter and the units are well ventilated. Air-line-type respirators shall be used when the cartridge type is ineffective due to providing too short a work time before the cartridge becomes contaminated and an odor is sensed. When an air-line respirator is used, a

minimum of two working respirators must be available on the job before any employee is allowed to enter the circuit breaker tank.

**L. Working on or near LV, MV, HV or EHV equipment:**

Many electrical hazards and work practices are the same regardless of the voltage involved. However, due to the nature of high voltage work, there are many hazards and work practices that are specifically related to high voltage. The following shall be checked:

1. First of all a permit to work is obtained before any person is allowed access to carry out any work on any High or Extra High voltage system.
2. Before grounds are installed, the de-energized line or equipment shall be tested for voltage. Appropriate tests for the nominal voltage involved (audio or visual) shall be used. They shall be tested immediately before and after use to verify that they are in good working condition.
3. Employees attaching and removing grounds shall comply with the following:
   (i) Grounding equipment shall be visually inspected and all mechanical connections checked for tightness before each use.
   (ii) The surface to which the ground is to be attached shall be clean before the grounding clamps installed / or a self-cleaning clamp shall be used.
   (iii) No ground shall be removed until all personnel are clear of the temporary grounded lines or equipment. When the grounding set is removed it shall disconnected from the line or equipment end first with an approved hot-line tool and moved to a point clear of energized conductors before the ground end is disconnected.
   (iv) All electrical systems /equipment shall be considered as live unless it is confirmed to be dead after using approved indicators to verify that the system / equipment is not live.
   (v) Only authorized person to climb structures or equipment which bring them under reduced clearance to live parts.
   (vi) New electrical system / equipment shall not be placed in service without the approval of the manager in charge and until the same has been thoroughly examined and tested by him.
   (vii) When testing, switching or doing other work in a particular locations of the working zone is likely to effect the operation is any other locations, the authorized person shall inform all the concerned before the work is started and after the work is completed.
   (viii) Danger notice - barriers and screens shall be fixed and moved only under the supervision of the authorized Person.
   (ix) The authorized person shall supervise the work and shall remain present at the point of work till the job is over.
   (x) All specific guidelines from the safety point of view applicable to installation and maintenance work of the specific / equipment as given in the respective manuals shall also be followed.
4. Competent persons to be authorized strictly for any / all of the following purposes.
   (i) Handling of electrical supply lines and apparatus.
   (ii) Working in panels where energy is supplied, converted, transformed or used at Medium, High or Extra High Voltage (i.e. above 250V)
   (iii) All operations in connection with High and Extra High Voltage (i.e. above 650 V) (iv) Working on / adjacent to any live line or apparatus
5. Contractual workers / supervisors shall obtain competency certificates from State Electrical Inspectorate
6. Company staff shall be authorized based on their qualification and experience, as competent for specific important tasks. Such tasks may include among others
   (i) Applying / Issuing / Receiving Permit for electrical work
   (ii) Working on HV/ EHV equip & Installations, Motors / Generators above 650 volts, Drive Control systems, MCC panels etc.
   (iii) Testing of protection relays / other tests & measurements
   (iv) Running Inspection / Condition Monitoring / lubrication / etc

7. List of authorized persons shall be signed by both the authorizer and authorizes. Such lists shall be displayed in the office of the authorizer and related workplaces.
8. The list shall be reviewed once in a year or so to ensure coverage of all areas & replacement of persons in case of Separation / Transfer / Promotion / Change in responsibility etc.

**M. Procedure for adding or removing equipment to or from the HV or EHV system:**
There may be three occasions when we need to remove an equipment from system or add on to such system.

1. As a preparatory of maintenance activity. Safe isolation and normalization procedure, is a normal day- to-day activity for handing over an equipment for maintenance and putting it back into service after maintenance.
2. During load balancing. This happens at the user / load end (and not at generating end) during any abnormality at generating end.
3. For islanding in case of grid failure and re-synchronizing with grid.

**a)Sequence of isolation / normalization steps:**

**I. Isolation / De-energizing**

1. Notify all concerned persons as to the hazard source, its control, and its possible stored energy.
2. Shut down the system by isolation of energy sources. System is rendered non-operative.
3. Secure all energy source shutdowns by lockout / tagout of controls.
4. Release all stored energy and verify such release.
5. Verify by testing there is no voltage.
6. Provide temporary grounding (Ref. A2 below)

**II. Re-energizing**

1. Inspect the work area for an operationally intact system and remove nonessential items.
2. Notify all affected workers that the system is to be re-energized and warn them to stand clear.
3. Remove temporary grounding.
4. Remove the lockout / tag out devices.
5. Visually determine that all affected workers are clear of the circuit.
6. Proceed with restoring service.

**b) Hazardous Energy Elimination:** Eliminate any source of hazardous energy affecting the work by controlling electrical / nonelectrical energy hazards
I. Electrical systems / equipment

i) Isolating by control operation:

1. Open switching devices; lockout if possible
2. Pull plugs or fuses
3. Block interlock feedbacks

ii) Stored or other energy release:

1. Disconnect and discharge capacitors, choke coils, and surge arresters.
2. Discharge static electricity.
3. Temporarily short to ground induced voltage from adjacent lines, static charges, accidental connections, and incorrect disconnections.
4. Provide shielding for possible contact with energized parts

iii) Verify by testing there is no voltage on de-energized system / equipment.

iv) Non electric energy hazards

1. Check for chemical, electromagnetic, mechanical, pneumatic, thermal, and ultraviolet energy.
2. Isolate by blocking valve operations or other control operations for the above systems.
3. Discharge trapped energy by releasing pressure or by draining / purging lines and verify lack of rotation or dangerous temperatures.

**c) De-energized Line Grounding:**

1. Grounding is used to limit dangerous potentials. Permanent grounding is provided as a part of any electrical system to meet safety and design requirements. A ground system consists of a grounding connection, a grounding conductor, a grounding electrode, and the earth (soil) that surrounds the electrode or some conductive body which serves instead of the earth (a ship hull/aircraft frame). A jumper connects conductors so that continuity is maintained. Bonding is the joining of metallic parts to form a conductive path. Temporary grounds are used so that work may be safely done on parts of the system that are temporarily isolated and cleared (de-energized).
2. Energized lines over 50 volts which have been opened and checked as showing no voltage must be considered as hot if they have not been grounded. Potential differences can occur on de-energized lines from any of the factors. Hence, temporary grounding is essential for safety. Causes of hazardous induced potential differences:
   (i) Potential differences caused by various line effects (such as induced voltages from adjacent energized lines and electrostatic build-up from wind action).
   (ii) Lightning strikes anywhere in the circuit.
   (iii) Fault-current feed-over from adjacent energized lines.
   (iv) Connection to an energized source through switching equipment, either by equipment malfunction or human error.
   (v) Accidental contact of the de-energized line with adjacent energized lines. (vi)
   Residual charge from power-factor correction capacitors or surge arresters.
3. Whenever possible install temporary grounding to provide an equipotential zone at the work site. An equipotential zone provides a zero ground potential gradient across a worker's body, thus preventing a harmful electrical current through the worker.
4. Grounds will be installed as close as possible to the work.

**d) Temporary grounding connection / removal procedures:**

1. Select a ground electrode using either an established ground at the structure or a temporarily driven ground rod. The selection shall minimize impedance and not introduce a hazardous potential difference.
2. Test the de-energized line/equipment for voltage by an approved tester, verified immediately before and after use as to its good working condition.
3. Visually inspect ground equipment. Check mechanical connections for tightness. Clean clamp jaws and conductor surfaces. Clean not earlier than 5 minutes before connection using a wire brush attached to a hot-line tool. Use of self-cleaning equipment is also acceptable.
4. The ground end clamp of each grounding cable shall always be the first connection made and the last to be removed. Hot sticks will be used if the grounded system and worker are at different potentials.
5. The conductor-end clamps of each grounding cable will always be connected last and removed first by hot sticks. Apply to the nearest conductor first and proceed outward and/or upward until all phases have been connected. Remove in reverse order. The practice of holding the cable near the base of the hot stick to lighten the load on the head of the stick is strictly prohibited. Instead, a co-worker shall assist in installing heavy cables by holding the cable with another hot stick, or by using a "shepherd hook" with a pulley and a nonconductive rope to hoist the grounding cable into position.

**e) Stringing/removing conductor ground locations:**

1. Ground all stringing equipment such as reel stands, pullers, tensioners, and other devices.

2. Provide a safety barrier around the equipment.
3. Install a running ground between pulling and tensioning equipment and their adjacent structures.
4. Ground stringing blocks at first and last structures, and at least every 2 miles (3.2 kilometers) in between.
5. Ground stringing blocks at each structure on both sides of an energized circuit being crossed. If the design of the circuit interrupting devices protecting the lines so permits, the automated reclosing feature of those devices shall be made inoperative.

**f) Conductor ground location after pulling:**

1. Ground at each structure next to intermediate dead ends of the stringing operation.
2. Ground at each structure where and while work (including clipping-in) is being performed on or near the conductor.
3. Remove grounds as the last phase of finished aerial installation.

## CHAPTER 77: SAFETY MEASURES IN OVERHEAD LINES

1. Every overhead line (not being suspended from a dead bearer wire and not being covered with insulating material and not being a trolley-wire) erected over any part of a street or other public place or in any factory or mine or on any consumer's premises shall be protected with a device approved by the inspector for rendering the line electrically harmless in case it breaks.
2. 400 kV and 220 kV transmission lines are provided with double main protections based on independent principles. Two stages over voltage protection is provided on 400 kV lines. 132 kV lines are provided with one distance protection and other directional O/C and E/F protection.
3. An Inspector may by notice in writing require the owner of any such overhead line wherever it may be erected to protect it in the manner specified in rule.
4. The owner of every high and extra-high voltage overhead line shall make adequate arrangements to the satisfaction of the Inspector to prevent unauthorized persons from ascending any of the supports of such overhead lines which can be easily climbed upon without the help of a ladder or special appliances. Rails, reinforced cement concrete poles and pre-stressed cement concrete poles without steps, tubular poles, wooden supports without steps, I-sections and channels shall be deemed as supports which cannot be easily climbed upon.
5. No work is allowed to be carried out at or near an overhead transmission line by any person other than an authorized person or by competent persons under the supervision of an authorized person / supervisor.
6. No such work it to be started without a line clearance / Permit-to-work issued by an authorized person.
7. Height Barriers shall be used in conjunction with ground-level barriers to restrict the locations where machinery or other plant and equipment can cross safely under an overhead line.
8. Do not attempt to directly measure the height of overhead power lines. Do not use conductive metallic objects or metal tape for measuring the height of overhead power lines.
9. Before starting any work under overhead line, a Site-specific Risk Assessment exercise is to be carried out, taking into account the maximum potential height that can be reached by the plant or equipment that will be used. If the equipment is capable of reaching a height of more than 4 metres, then further safety control measures will need to be put in place.
10. Check points before start of work:
    (i) Nature of work and ways of dealing with changes as the work proceeds
    (ii) The possible hazards and risks associated with the work
    (iii) Consultation with the network operator
    (iv) Communication and interaction between workers at the site

(v) Training, qualifications and competency of workers
(vi) Checking the operation of plant & equipment, including control devices (vii)
Proximity of persons, cranes, mobile plant, material and tools to OH lines (viii)
Proximity of persons to cranes and mobile plant
(ix) Specific instructions for employees
(x) Workplace access and egress
(xi) Emergency procedures, including first aid, evacuation and rescue; and
(xii) Environmental factors (Do not work in cloudy, rainy or stormy weather)

## CHAPTER 78: INSPECTION AND MAINTENANCE OF STEEL TOWERS AND STRUCTURES

The main concern of energized towers is corrosion. It takes long time for corrosion to put its mark on a energized tower / pole, depending on the climatic condition and pollution level. While galvanized steel in rural or desert settings may remain rust-free for up to 50 years, coatings in salty coastal air or heavy industrial environments may only do so for 15 years or less. Unfortunately, once the corrosion of a galvanized transmission tower/pole does begin, it advances exponentially. A tower/pole with less than 5 percent rust at age 30 can oxidize to the point of failure within ten years. More critically, as the corrosion of the tower/pole accelerates, so too can the cost of time, labour and materials to repair it. The phases of transmission tower corrosion:

Phase 1: Coffee stain rust (cosmetic, not structural)
1. 5% rust
2. On edges and bolts
3. About 1 mils to 2 mils of galvanization remains

Phase 2: Abrasive rust
1. On bolts, edges and horizontal flat areas
2. Rust falls off on touch

Phase 3: Extensive abrasive rust

Phase 4: The tower falls

**A. Inspection of Tower and structure:**

The reputed tower manufacturers recommend that a structural inspection be done annually and/or after any severe weather. Standard checklist for inspection of towers is given below.
a)Tower Inspection checklist:
1. Visual inspection from the ground prior to climbing. Address any safety concerns or hazards prior to proceeding
2. Visual inspection of guy anchors without digging (for guyed tower)
3. Tension readings from guy wires (for guyed towers)
4. Measurement of tower plumb / base flange heights to verify that tower is plumb and not settling
5. Visual inspection of lighting system for proper function
6. Verify operation of photo cell switch, if any
7. Check 10% of hardware for tightness
8. Check weep holes if applicable
9. Visual inspection of safety climb if applicable
10. Visual inspection of antennas and transmission lines

11. Visual inspection of overall tower condition noting any potential problems
12. Visual inspection of paint condition
13. Visual inspection of overall site condition

**Note:**

1. Only authorized persons shall be allowed to carry out tower inspection and subsequent maintenance, painting etc.
2. During 'climbing inspection' look out for defects like – bent / broken / missing member, loose bolts, broken / chipped insulators, poor condition of the ground wire at the attachment point, rust on the wire or signs of corrosion etc.

b) After inspection, depending on their physical condition, the towers can be energized in three groups:

1. Protected structure: Those having sufficient galvanized or maintenance coating protecting the steel. This allows them to be placed in the later years of maintenance cycle.
2. Stained structures: Those which are still being protected by a thin layer of galvanized coating on the steel surface. This is the stage just before corrosion of the steel begins. The thin layer of galvanized coating will have a light brown color and will be smooth to the touch. Maintenance of these structures normally requires minimal surface preparation and one coat of standard coating material.
3. Corroded structures: These structures have lost all of their protective galvanized and/or maintenance coating. The steel surface is also rusting, thus losing structural integrity. The surface will be rough and/or pitted, and rust particles normally will come off when rubbed.

**B. Maintenance of towers and structures:**

Corroded structures require more extensive surface preparation and a surface tolerant primer prior to finish coat. As a result, it is far more costly to maintain corroded structures than those in the stained condition. In fact, the cost could be double of the stained structures.

In maintenance painting schedule, the priority1 are the stained structures, priority 2 the corroded structures and protected structures come as Priority 3 i.e.at the end of the schedule. From a coating perspective, This proactive approach reduces maintenance costs by not allowing stained structures to reach the more costly corroded condition.

## CHAPTER 79: NORMS FOR PATROLLING OF LINES

As per Article 23 of CEA Regulation 2010 (Grid Standard):

1. All essential parameters, which indicate the healthiness of the equipment in a sub-station, shall be inspected by the shift engineer once in each shift and periodically by the officer-in-charge.
2. Overhead lines shall be patrolled at periodicity decided by the transmission licensee and different patrolling schedules shall be implemented by the transmission licensees for normal terrain, vulnerable terrain and most vulnerable terrain.
3. The patrolling schedules for ground inspection of live lines and tower top inspection of de-energised lines shall be separately issued by the licensees.
4. The important lines shall be inspected by senior engineers after patrolling by junior staff and maintenance works such as tree cutting and replacement of damaged insulators shall be carried out immediately after patrolling, wherever required.
5. As per IS 5613, All overhead lines shall be patrolled periodically at intervals not exceeding 3 months from the ground when the line is live.

## CHAPTER 80: CLASSIFICATION OF TERRAIN OF ELECTRIC LINES i.e. NORMAL TERRAIN AND VULNERABLE TERRAIN

Terrains are generally classified based on pollution level in the area. The design of insulators changes depending on the level of pollution. The creepage distance has to increase with increased level of pollution. As per IEC 60815, considerable increase in creepage distance is required to counter the increase in pollution levels from lower severity to higher severity level. While the Indian Standard for insulators (IS 731) defines only two levels of pollution (Medium and Heavy) IEC 60815 defines four levels (light, medium, heavy and very heavy).

## CHAPTER 81: THERMO VISION SCANNING

It is one of the diagnostic tools for condition monitoring. The Thermo-vision scanning for hot spots on all overhead lines and sub-station equipment at voltage level of 220 kV and above shall be carried out at least once a year and necessary remedial measures shall be taken where hot spots are detected.

## CHAPTER 82: PUNCTURED INSULATOR DETECTION

As per the recommendations of the Regional Power Committee (RPC) inquiry committee constituted by CEA on the grid incident in the northern region in January 2007 –

1. Detection of punctured insulators needs to be carried out using hotline puncture detectors and change of punctured insulators so identified shall be replaced during scheduled maintenance. For medium, heavy and very heavily polluted stretches the replacement shall be effected before onset of winters i.e October every year.
2. For change of insulator strings, as far as possible hot line techniques may be followed and necessary hotline tools & gadgets and trained manpower be employed. On-line tools shall include thermo-vision camera for detection of hot spots and live line punctured insulator detector.

## CHAPTER 83: OFF-LINE FAULT LOCATION, SIGNATURE ANALYSIS

For condition assessment / fault location of conductors, clamps, connectors, insulators etc, provision for off-line diagnostic tools are available. Off-line tools include insulation resistance measuring instrument and contact resistance measuring instrument. While On-line measuring depends mostly on Protection Relays, EHV AC Transmission line Analyzer is a state of the art offline portable kit, capable of detecting accurately any fault on EHV Transmission lines and also helps in venturing beyond, into innovative line signature analysis study, useful in predictive maintenance of Transmission lines. Thus Off-line Fault Locators can be used during patrolling of lines and detects potential faults which can be brought back to normalcy through timely maintenance. This will result in long trouble free operation of overhead transmission lines.

## CHAPTER 84: MAINTENANCE SCHEDULE OF ELECTRIC LINES

1. Maintenance crews shall be posted at locations within wireless / telephone link so that during emergency at any part of the line can be attended within the shortest possible time.
2. A small store house containing spare parts such as insulators, cable length, clamps shall be located intermediate to maintenance posts. There shall be routine inspection for stock checking.
3. A light truck with two way communication facility and equipped with necessary tools, tackles and materials for urgent repair work of the line shall be made available.
4. Battery operated spotlights shall be provided.
5. A Wireless power-line sensor hangs from an overhead power line and sends measurements to a data collection system. Because the sensor does not touch anything but a single live conductor, no high- voltage isolation devices are needed. The sensor is installed simply by clamping it around a conductor. The sensor powers itself from energy scavenged from electrical or magnetic fields surrounding the conductor being measured.
6. Overhead power line monitoring helps distribution system operators provide reliable service at optimized cost. The primary purpose of a power line sensor is to measure current, however, they can monitor other operating parameters such as Conductor temperature, Ambient temperature, Inclination or the amount of line sagging, Wind movement and Electric fields.
7. The maintenance of transmission line is in following steps: (i)
   Routine patrolling and inspection
   (ii) Cleaning insulators periodically where necessary
   (iii) Tightening of clamps and fixtures periodically
   (iv) Replacement of cracked insulators
   (v) Clearing of trees, bushes etc
   (vi) Inspection of earthing
   (vii) Checking of towers for corrosion and remedial actions

## CHAPTER 85: SAFETY IN WASHING OF LIVE INSULATORS AND TESTING OF INSULATORS ON LIVE LINES

As per the recommendations of the Regional Power Committee (RPC) inquiry committee constituted by CEA on the grid incident in the northern region in January, 2007:

1. Cleaning of insulators may be completed by 15th November every year for all affected stretches. For very heavy pollution stretches the cleaning may be completed by 15th Dec so that pollution deposits shall be minimum during foggy days.
2. Cleaning of insulators in the polluted areas with non-washable contamination, shall be effected as per the procedures indicated in IEEE guidelines.
3. For cleaning of insulators in polluted areas with washable contamination, the present practice of manual cleaning of insulators may be progressively replaced with high pressure.
4. Water jet live line washing wherever approach of truck mounted or telescopic boom washers are feasible. Else the practice of replacing polluted insulator string with cleaned insulator string may be adopted.
5. The polluted insulator string removed from the line shall be washed/ cleaned at ground level and reused for replacing polluted insulator strings at subsequent locations.
6. Helicopter live line washing needs to be resorted to in the areas where approach of truck mounted washers / telescopic boom washers is not feasible or where due to high pollution and its faster accumulation, speed of operation so demands. While practicing helicopter washing the safety considerations as per the IEEE guidelines needs to be ensured. On an average, the helicopter needs to be utilized for approx. 5 hours per day or for effecting cleaning of approx. 10 circuit-km stretch of line.
7. High pressure water jet cleaning shall not be practiced on polymer insulators.
8. No detergent or soap water be used for cleaning of line insulators under energized conditions. If used for cleaning during un-energized conditions, this shall be followed by a low-pressure flood rinse with clean water to remove any residue.
9. Solvents may be used only after manufacturer approval, provided all cleaning residue are removed by the final clean water rinse.
10. For selection of insulator strings, the committee has suggested that –
    (i) Present practice of using porcelain insulator string units of 292 to 350 mm creepage distance may be continued to be employed in light pollution areas. In areas exposed to heavy fog and medium pollution level antifog insulators discs of creepage distance of 430 mm or higher (corresponding to creepage distance of 22 mm /kV for 400kV lines with 23 discs) or
    (ii) Porcelain long rod insulators offering equal creepage distance may be employed with insulator profile as per IEC 60815. In areas exposed to heavy fog and heavy & very heavy pollution levels composite long rod (polymer) insulators with silicon impregnated (SIR) weather sheds having creepage distance of 25mm/kV & 31mm/kV respectively may be employed.
    (iii) In respect of lines in operation, insulator strings shall be progressively replaced as per above depending upon pollution levels.
    (iv) The quality of insulator cleaning whether by wet cloth or by pressurized water jet is dependent on adoption of correct methodology by the operator and better supervision (more so where it is outsourced). The operators /supervisors may be provided training in cleaning / replacement of insulator strings on de-energised line as well as live line working.

## CHAPTER 86: HOT LINE MAINTENANCE

Under normal condition, all maintenance work shall be carried out in de-energised condition. However, during emergency situations to avoid / minimize human injury / loss of property, work may have to be carried out in energized condition (partly / fully) i.e. Hot Line Maintenance. Such work will strictly be carried out by competent persons. In case of planned work in energized condition, a step by step protocol will be prepared including activity break-ups, sequence of execution, job responsibility and duration. One senior officer from executing agency will be made responsible for safe execution of the entire work as per plan. Besides energized operation and maintenance managers, the protocol will be signed by all others who may be affected directly or indirectly. The protocol will be approved by Unit Head.

**A.Two principles for safe live line maintenance**:

1. The person is insulated from ground or grounded parts by means of special platforms, special tools, gloves, shoes etc thereby the contact current through body to earth is eliminated.
2. The person is provided with shielding metallic cage which is connected to the live part but is insulated from earth; thereby the electric field stress across the person is eliminated.

**B.Conditions for Hot Line Maintenance**:

a)Do not start work until the following conditions are completed:

1. Obtain Hot Line maintenance approval
2. Determine existing condition and complete the Job Hazard Analysis
3. Determine voltage rating of circuit to be worked on, distances to other energized lines and location of work
4. Prepare a written work procedure / protocol
5. Review work and safety precautions with the working group
6. Evaluate
   (i) Safe working distance based on line voltage
   (ii) If aerial lift / Sky lift (platform and cage which can be raised / lowered, rotated / held in position from ground control) equipment can be used
   (iii) Personnel qualification / competency required. At least two workers, fully qualified for the voltage range (including other conductors within reach), must be available.
   (iv) If special equipment, tools or hazard protections are needed
7. Inspect tools and equipment before work starts
   (i) Insulating mats of good quality and conforming to relevant standards
   (ii) Insulating ladder usually made of laminated epoxy resin bonded wood section or Fibre-glass resin insulated section.
   (iii) Insulated tongs and other insulated tolls for repair
   (iv) Leather protectors over rubber gloves
   (v) Insulating guard equipment and insulating tools as per standards, preferably of FRP (Fiberglass Reinforced Plastic)
   (vi) Approved gloves and rubber insulating sleeves with hot-line tools. (Use of hot-line tools without gloves to detect tool deterioration is discouraged).
   (vii) Complete instructions and regulations detailing correct use and maintenance of such tools/equipment shall be available and reviewed as a part of the work procedures.

**C.Energised Work (Hot Work) precautions**:

1. Check that circuit automatic reclosing devices have been made inoperative while work is being performed.
2. All items of a voltage class lower than required for the work shall not be available to the workers at the work site.

3. Exercise special care when working in the proximity of equipment such as fuses, surge arresters, and similar equipment, or where conductor checks indicate burns or other defects in conductors, tie wires, and insulators. Procedures may require that some equipment be bypassed for the duration of the work.

## CHAPTER 87: SAFETY IN WORKING IN UNDERGROUND SYSTEM

### A. General:

Electrical work in underground structures such as manholes, poorly ventilated vaults, tunnels etc calls for both Electrical as well as Confined space entry permit. Such activities require –

1. Testing / monitoring of inside air quality
2. Ensure adequate ventilation
3. Respiratory protection and other PPEs and
4. Training

Existing Utility Protection (during excavation): Locate and mark existing utilities in work areas where excavations are to be made. Digging restrictions may apply. Coordinate with the appropriate maintenance group or the fire department for unexpected hazards.

### B. Precautions before entering a manhole:

1. Secure the work area.
2. Use the probes of an atmospheric tester to check air. First check for moisture on the end of the probe. If none found, test for air.
3. If air is acceptable, remove manhole cover.
4. Inspect the structure interior for the presence of water, oil, gasoline, or other contaminants which must be removed before work can proceed. Then check the structure by lowering the probe as far as possible.
5. If air is acceptable, set up the lifting A-frame on the manhole.
6. Enter (and leave) the structure by means of a ladder or climbing device for structures more than 4 feet (1.2 meters) deep. Never climb in or out by stepping on cables or their supports.
7. Test the air at each corner of the structure and at each of the duct entrances.
8. Provide additional ventilation as necessary. Continuous monitoring of air quality shall be performed for work taking longer than 15 minutes. Whenever the cover has been replaced, repeat air testing.
9. Lower tools using a hand line. Use the A-frame for heavy tools and parts, or when a manhole rescue must be made.

### C. Precaution when working on underground structures:

1. Use only flashlights or facility approved lighting units for illumination.
2. Never have open flames inside the structure and avoid spark producing connections/ disconnections.
3. Move energized cables only when specifically approved. Never change energized cable bends.
4. Splicing and terminating of cable must be done by qualified cable splicers / terminators.
5. Equipment for heating cable splicing materials will be operated only by workers trained in such use.

### D. Precautions during cable work in underground structures:

1. Identify cables to be worked on and examine them for any damage.
2. Protect the work space by covering all live parts and cables with temporary insulation.
3. De-energize a cable and test for no voltage after waiting long enough for the dissipation of any static or capacitive charges. This period will be at least 5 minutes for capacitors with internal discharge resistors and at least twice the duration of an applied voltage test (“Hi-Pot”).

4. Ground the de-energized cable downstream from all sources of electric power and on both sides of the work location as hazardous potential differences may occur on de-energized (but not grounded) cables.

5. Proceed with cable work (such as cutting, re-splicing, other reconnections, and fireproofing) in accordance with standard work procedures.

## CHAPTER 88: LIST OF SELECT INDIAN STANDARDS ON SAFETY & HEALTH

### GENERAL

| Sl. No. | IS Code No. | Particulars of IS Code |
|---|---|---|
| 1 | IS 3646 : 1922 Part 1 | Code of practice for interior illumination General Requirements and recommendations for welding interiors |
| 2 | IS 3646 : 1968 Part 3 | Code of practice for interior illumination – Calculation of coefficients of utilization by the BZ method. |
| 3 | IS 3786 : 1983 | Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents. |
| 4 | IS 5182 : Part 1 to 23 | Methods for measurement of Air Pollution |
| 5 | IS 8095 : 1976 | Specification for Accident Prevention Tags |
| 6 | IS 11972 : 1987 | Code of practice for safety precautions to be taken when entering a sewerage system. |
| 7 | IS 14489 : 1998 | Code of practice on occupational safety and health audit. |
| 8 | IS 14624 : 1998 Part 2 | Safety of laser products : Safety of optical fiber communication system |
| 9 | IS 15296 : 2003 | Industrial Automation systems – Safety of Integrated Manufacturing Systems –Basic Requirements |
| 10 | IS 15551 : 2003 | Quality Management Systems – Guidelines for Process Improvements in Health Service Organizations |
| 11 | IS 18001 : 2000 | Occupational Health and Safety Management Systems – Specification with Guidance for use |

### Personal Protection:

#### Body.

| | | |
|---|---|---|
| 12 | IS 3322 : 1987 Part 1 | Specification for water resistant clothing- PVC coated fabrics |
| 13 | IS 3521 : 1999 | Industrial safety belts and harnesses – Specification |
| 14 | IS 4501 : 1981 | Specification for aprons, rubberized, acid and alkali resistant |
| 15 | IS 5915 : 1970 | Specifications for single texture rubberized waterproofing fabrics |
| 16 | IS 6153 : 1971 | Specification for protective leather clothing |
| 17 | IS 7352 : 1974 | Specification for X-ray lead rubber protective aprons |
| 18 | IS 8519 : 1977 | Guide for selection of industrial safety equipment for body protection |
| 19 | IS 8990 : 1978 | Code of practice for maintenance and care of industrial safety clothing |

#### Ears.

| | | |
|---|---|---|
| 20 | IS 6229 : 1980 | Method for measurement of real ear protection of hearing protectors and physical attenuation of ear muffs |
| 21 | IS 8520 : 1977 | Guide for selection of industrial safety equipment for eye, face and ear protection |
| 22 | IS 9167 : 1979 | Specification for ear protectors |

#### Eye and Face.

| | | |
|---|---|---|
| 23 | IS 1179 : 1967 | Specification for equipment for eye and face protection during welding |
| 24 | IS 2553 : 1992 Part 2 | Safety glass- Specification for road transport |
| 25 | IS 5983 : 1980 | Specifications of eye protectors |
| 26 | IS 7524 : 1980 Part 1 | Method of test for eye protectors:- Non – optical tests |

| | | |
|---|---|---|
| 27 | IS 8521 : 1977 Part 1 | Industrial safety face shields – with plastic visor |
| 28 | IS 8521 : 1994 Part 2 | Industrial safety face shields – with wire mesh visor |
| 29 | IS 8940 : 1978 | Code of practice for maintenance and care of industrial safety equipment for eyes and face protection |
| 30 | IS 9973 : 1981 | Specification for visor for scooter helmets |
| 31 | IS 9995 : 1981 | Specification for visor for non-metal police and firemen's helmets |
| 32 | IS 14352 : 1996 | Miners safety goggles – Specification |

**Feet and Legs.**

| | | |
|---|---|---|
| 33 | IS 1989 : 1986 Part 1 | Specification for leather safety boots and shoes – for miners |
| 34 | IS 1989 : 1986 Part 2 | Specification for leather safety boots and shoes – for heavy metal industries |
| 35 | IS 3737 : 1966 | Leather safety boots for workers in heavy metal industries |
| 36 | IS 3738 : 1998 | Rubber boots – Specification |
| 37 | IS 3976 : 2003 | Protective rubber canvas boots for miners – Specification |
| 38 | IS 4128 : 1980 | Specification for fireman's leather boots |
| 39 | IS 5557 : 1999 | Safety Rubber boots – Specification |
| 40 | IS 5852 : 1996 | Protective steel toe caps for footwear – Specification |
| 41 | IS 6519 : 1971 | Code of practice for selection, care and repair of safety foot wear |
| 42 | IS 7329 : 1974 | Metal last for safety rubber canvas ankle boots |
| 43 | IS 9885 : 1981 Part 1 | Protective boots for oilfield workmen-Leather upper boots |
| 44 | IS 9885 : 1982 Part 2 | Protective boots for oilfield workmen-Rubber upper boots |
| 45 | IS 10348 : 1982 | Safety footwear for steel plant |
| 46 | IS 10665 : 1982 | Safety rubber ankle boots for miners |
| 47 | IS 10667 : 1983 | Guide for selection for industrial safety equipment for protection of foot and leg |
| 48 | IS 11225 1985 | Leather safety shoes for women workers in mines and steel plants |
| 49 | IS 11226 : 1993 | Leather safety foot wear having direct moulded rubber sole – Specification |
| 50 | IS 11264 : 1985 | Code of practice for manufacture of safety rubber footwear for miners |
| 51 | IS 12254 : 1993 | PVC industrial boot specification |
| 52 | IS 13038 : 1991 | PVC Boots, oils and fats resistant- Specification |
| 53 | IS 13292 : 1992 | PVC Boots, chemical resistant- Specification |
| 54 | IS 13295 : 1992 | Code of practice for manufacture of leather safety boots and shoes for workers in mines and heavy metal industry |
| 55 | IS 13575 : 1992 | Lined antistatic rubber footwear- Specification |
| 56 | IS 13695 : 1992 | Rubber Boots, chemical resistant- Specification |
| 57 | IS 14544 : 1998 | Leather safety footwear with direct moulded PVC soles – Specification |
| 58 | IS 15298 : 2002 Part 2 | Safety, protective and occupational footwear for professional use – Specification for safety footwear |

**Hands**

| | | |
|---|---|---|
| 59 | IS 2573 : 1986 | Specification for leather gauntlets and mittens |

| | | |
|---|---|---|
| 60 | IS 4770 : 1991 | Rubber Gloves – electrical purposes – specification |
| 61 | IS 6994 : 1973 Part 1 | Specification for safety gloves – leather and cotton gloves |
| 62 | IS 8807 : 1978 | Guide for selection of industrial safety equipment for protection of arms and hands |

**Head.**

| | | |
|---|---|---|
| 63 | IS 2745 : 1983 | Specification for non-metal helmet for firemen and civil defence personnel |
| 64 | IS 2925 : 1984 | Specification for industrial safety helmets |
| 65 | IS 4151 : 1993 | Specification for protective helmets for scooter and motor cycle riders |
| 66 | IS 5679 : 1986 | Miner's cap lamps assemblies (incorporating lead acid type batteries) |
| 67 | IS 9562 : 1980 | Non metal helmets for police force |

**Respiratory.**

| | | |
|---|---|---|
| 68 | IS 8318 : 1977 | Colour identification markings for air purifying canisters and cartridges |
| 69 | IS 8347 : 1977 | Glossary of terms relating to respiratory protective devices |
| 70 | IS 8522 : 1977 | Respirators, chemical cartridge |
| 71 | IS 8523 : 1977 | Respirators, canister type (gas masks) |
| 72 | IS 9473 : 2002 | Respiratory protective devices – Filtering half masks to protect against particles – specification |
| 73 | IS 9563 : 1980 | Carbon monoxide filter self rescuers |
| 74 | IS 9623 : 1980 | Recommendations for the selection, use and maintenance of respiratory protective devices |
| 75 | IS 10245: 1982 Part 1 to 4 | Breathing apparatus |
| 76 | Is 14166 : 1994 | Respiratory protective devices- Full face masks- Specification |
| 77 | IS 14746 : 1999 | Respiratory protective devices- Half masks and quarter masks- Specification |
| 78 | IS 15322 : 2003 | Particle filters used in respiratory protective equipment – Specification |
| 79 | IS 15323 : 2003 | Gas filters and combined filters used in respiratory protective equipment – Specification |

**Other safety code.**

| | | |
|---|---|---|
| 80 | IS 5424 : 1969 | Specification for rubber mats for electrical purpose |
| 81 | IS 6685 : 1972 | Specification for life jackets |
| 82 | IS 10592 : 1982 | Specification for industrial emergency showers, eye and face fountains and combination units |
| 83 | IS 11006 : 2011 | Flash back arrestor (flame arrestor) specification |
| 84 | IS 11057 : 1984 | Specification for industrial safety nets |
| 85 | IS 12078 : 1987 | Recommendations for personal protection of workers engaged in handling asbestos |
| 86 | IS 9457 : 1980 | Code of practice for safety colours and safety signs |
| 87 | IS 10224 : 1982 | Ergonomic principles in the design of work system |
| 88 | IS 12418 : 1987 | Ventilation ducting- Vinyl coated, semi rigid |
| 89 | IS 13293 : 1992 | Gas detector tubes- General requirement and method of test |
| 90 | IS 2379 : 1990 | Colour code for identification of pipe lines |

**Fire Protection.**

| | | |
|---|---|---|
| 91 | IS 1641 : 1988 | Code of practice for fire safety of buildings (general) : General principles of fire grading and classification |
| 92 | IS 1642 : 1989 | Code of practice for fire safety of buildings (general) : Details of construction |
| 93 | IS 1643 : 1988 | Code of practice for fire safety of buildings (general) : Exposure hazard |
| 94 | IS 1644 : 1988 | Code of practice for fire safety of buildings (general) : Exit requirements and personal hazard |
| 95 | IS 1645 : 1960 | Code of practice for fire safety of buildings |
| 96 | IS 1646 : 1997 | Code of practice for fire safety of buildings (general) : Electrical installations |
| 97 | IS 1647 : 1960 | Code of practice for fire safety of buildings |
| 98 | IS 1648 : 1961 | Code of practice for fire safety of buildings (general) : Firefighting equipment and its maintenance |
| 99 | IS 2171 : 1999 | Portable fire extinguishers, Dry Powder (cartridge type)- specification |
| 100 | IS 2189 : 1999 | Selection, installation and maintenance of automatic fire detection and alarm system code of practice |
| 101 | IS 2190 : 1992 | Selection, installation and maintenance of first aid fire extinguishers – code of practice |
| 102 | IS 2406 : 1963 | Code of practice for fire safety of non-industrial buildings |
| 103 | IS 2726 : 1988 | Code of practice for fire safety of industrial buildings : Cotton ginning and pressing (including cotton seed de-lintering) factories |
| 104 | IS 2878 : 2004 | Portable fire extinguishers, carbon-di-oxide type (portable and trolley mounted) |
| 105 | IS 3016 : 1982 | Code of practice for fire precautions in welding and cutting operations |
| 106 | IS 3034 : 1993 | Fire safety of industrial buildings: electrical generating and distributing stations – code of practice |
| 107 | IS 3594 : 1991 | Code of practice for fire safety of non-industrial buildings : General storage and ware housing including cold storage |
| 108 | IS 4989 : 2006 | Foam concentrate for producing mechanical foam for firefighting – specification |
| 109 | IS 5896 : 1970 Part 1 | Code of practice for selection, operation and maintenance of special fire fighting appliance – combined foam and co crash tender |
| 110 | IS 6234 : 2003 | Portable fire extinguisher water type (stored pressure) |
| 111 | IS 6382 : 1984 | Code of practice for design and installation of fixed carbon-di-oxide fire extinguishing system. |
| 112 | IS 8757 : 1999 | Glossary of terms associated with fire safety |
| 113 | IS 9668 : 1990 | Code of practice for provision and maintenance of water supplies and fire fighting |
| 114 | IS 10204 : 2001 | Specification for portable fire extinguishers, mechanical foam type |
| 115 | IS 11457 : 1985 Part 1 | Code of practice for fire safety of chemical industries : Rubber and plastic |
| 116 | IS 11460 : 1985 | Code of practice for fire safety of libraries and archives |
| 117 | IS 12456 : 1988 | Code of practice for fire protection of electronic data processing installation |
| 118 | IS 12459 : 1988 | Code of practice for fire safety in cable runs |
| 119 | IS 13716 : 1993 | Code of practice for fire safety of hotels |

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|---|---|---|
| 120 | IS 14435 : 1997 | Code of practice for fire safety in educational institutions. |
| 121 | IS 14850 : 2000 | Fire safety of museums – code of practice |
| 122 | IS 15394 : 2003 | Fire safety in petroleum refineries and fertilizer plants – code of practice |

**Civil Engineering Construction.**

| | | |
|---|---|---|
| 123 | IS 875 : 1987 Part 1 to 5 | Code of practice for design loads (other than earthquake) for buildings and structures dead loads |
| 124 | IS 1905 : 1987 | Code of practice for structural use of unreinforced masonry |
| 125 | IS 2750 : 1964 | Specification for steel scaffoldings |
| 126 | IS 3483 : 1965 | Code of practice for noise reduction in industrial building |
| 127 | IS 3696 : 1987 Part 1 | Scaffolds and Ladders – Code of Safety – Scaffolds |
| 128 | IS 3696 : 1991 Part 2 | Scaffolds and Ladders – Code of Safety – Ladders |
| 129 | IS 3764 : 1992 | Code of safety for excavation work |
| 130 | IS 4014 : 1967 Part 1 & 2 | Code of practice for steel tubular scaffolding – Part 1- common definitions and general guidance Part 2- safety regulations for scaffolding |
| 131 | IS 4081 : 1986 | Safety code for blasting and related drilling operations |
| 132 | IS 4082 : 1996 | Recommendations on stacking and storage of construction materials and components at site. |
| 133 | IS 4130 : 1991 | Safety code for demolition of buildings |
| 134 | IS 4138 : 1977 | Safety code for working in compressed air |
| 135 | IS 4435 : 1967 Part 2 | Trestles & Ladders |
| 136 | IS 4756 : 1978 | Safety code for tunneling work |
| 137 | IS 4912 : 1978 | Safety requirements for floor and wall openings, railings and toe boards |
| 138 | IS 5121 : 1969 | Safety code for piling and other deep foundations |
| 139 | IS 5878 : (Part 2 Sec 1) | Precaution for blasting in tunnels and shafts |
| 140 | IS 5878 : (Part 2 Sec 2) | Ventilation , lighting, mucking and dewatering in tunnels |
| 141 | IS 5916 : 1970 | Safety code for construction involving use of hot bituminous materials |
| 142 | IS 6609 : 1972 Part 5 | Methods of test for commercial blasting explosives and accessories : Part V Safety fuses |
| 143 | IS 6922 : 1973 | Criteria for safety and design of structures subject to underground blasts |
| 144 | IS 7205 : 1974 | Safety code for erection of structural steel work |
| 145 | IS 7293 : 1974 | Safety code for working with construction machinery |
| 146 | IS 7323 : 1994 | Operation of reservoirs – Guidelines |
| 147 | IS 7969 : 1975 | Safety code for handling and storage of building materials. |
| 148 | IS 8091: 2008 | Code of safe practice for industrial plant layout. |
| 149 | IS 8989 : 1978 | Safety code for erection of concrete framed structures |
| 150 | IS 9706 : 1997 | Aerial ropeways for transport of material – code of practice for design and construction |
| 151 | IS 9759 : 1981 | Guidelines for de-watering during construction. |
| 152 | IS 9937 : 1981 | Portable methanometer (electrical type) |
| 153 | IS 9944 : 1992 | Natural and manmade fibre rope slings – Recommendations on safe working loads |

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|---|---|---|
| 154 | IS 10291 : 1982 | Safety code for dress divers in civil engineering works |
| 155 | IS 10386 : 1992 Part 1 to 10 | Construction, operation and maintenance of river valley projects – safety code |
| 156 | IS 10386 : 1993 Part 7 | Safety code for Construction, operation and maintenance of river valley projects – Fire safety aspects |
| 157 | IS 10386 : 1983 Part 10 | Safety code for Construction, operation and maintenance of river valley projects – Storage, handling, detection and safety measures for gases, chemicals and flammable liquids |
| 158 | IS 11972 : 1987 | Code of practice for safety precautions to be taken when entering a sewerage system |
| 159 | IS 13063 : 1991 | Code of practice for structural safety of buildings on shallow foundations on rocks |
| 160 | IS 13415 : 1992 | Protective barriers in and around buildings – Code of safety |
| 161 | IS 13416 : 1992 Part 1 to 5 | Recommendations for preventive measures against hazards at work places |
| 162 | IS 13430 : 1992 | Code of practice for safety during additional construction and alteration to existing buildings |
| 163 | IS 14734 : 1999 | Balancing machines – enclosures and other safety measures |
| 164 | SP 70 : 2001 | Hand book on construction safety practices |

**Machinery / Operations.**

| | | |
|---|---|---|
| 165 | IS 659 : 1964 | Safety Code for air conditioning (revised) |
| 166 | IS 817 : 1992 Part 1 | Training of welders- code of practice metal arc welding |
| 167 | IS 817 : 1992 Part 2 | Training of welders- code of practice oxifuel welding |
| 168 | IS 818 : 1968 | Code of practice for Safety and Health Requirements in electric and gas welding and cutting operations. |
| 169 | IS 1991 : 1988 Part 4 | Safety requirements for the use, care and protection of abrasive grinding wheels: Safety guards. |
| 170 | IS 2762 : 1964 | Safe working load in kgs for wire rope sling |
| 171 | IS 2825 : 1969 | Code of unfired pressure vessels |
| 172 | IS 3233 : 1965 | Glossary of terms for safety and relief valves and their parts |
| 173 | IS 3483 : 1965 | Code of practice for noise reduction in industrial buildings |
| 174 | IS 5903 : 1970 | Recommendations for safety devices for gas cylinders. |
| 175 | IS 6044 : 2000 Part 1 | Code of Practice for Liquefied Petroleum Gas Storage Installations – Part 1 : Commercial and Industrial Cylinder Installations |
| 176 | IS 7155 : Part 1 to 8 | Code of recommended practice for conveyor safety |
| 177 | IS 7194 : 1994 | Assessment of Noise Exposure during work for hearing conservation purpose |
| 178 | IS 8089 : 1976 | Code of safe practice for layout of outside facilities in an industrial plant |
| 179 | IS 8091 : 1976 | Code of safe practice for industrial plant layout |
| 180 | IS 8216 : 1976 | Guide for inspection of lift wire ropes |
| 181 | IS 8235 : 1976 | Guide for safety procedures in hand operated hand tools |
| 182 | IS 8324 : 1988 | Code of practice for safe use and maintenance on non-calibrated round steel link lifting chains and chin slings |
| 183 | IS 8433 : 1984 | Code of safe practice for visual inspection of dissolved acetylene gas cylinders |
| 184 | IS 9020 : 2002 | Power Threshers – Safety Requirements |
| 185 | IS 9474 : 1980 | Specification for principles of mechanical guarding of machinery |

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|---|---|---|
| 186 | IS 10553 : 1983 Part 1 | Requirements for chlorination equipment : General guidelines for chlorination plants including handling, storage and safety of chlorine cylinders and drums |
| 187 | IS 10224 : 1982 | Ergonomic principles in the design of work systems |
| 188 | IS 11006 : 1984 | Specification for flash back arrestor (flame arrestor) |
| 189 | IS 11016 : 1984 | General safety requirements for machine tools and their operation. |
| 190 | IS 11461 : 1985 | Code of practice for compressor safety |
| 191 | IS 12735 : 1994 | Wire rope slings – safety criteria and inspection procedures for use |
| 192 | IS 13367 : 1992 Part 1 | Safe use of cranes – code of practice – General |
| 193 | IS 13583 : 1993 Part 1 | Cranes – Training of drivers : General |
| 194 | IS 14817 : 2004 Part 2 | Mechanical Vibration – Evaluation of machine vibration by measurements on non-rotating parts – large land based steam turbine generator sets in excess of 50 MW |
| 195 | IS 14817 : 2004 Part 4 | Mechanical Vibration – Evaluation of machine vibration by measurements on non-rotating parts – Gas Turbines driven sets excluding aircraft derivatives. |
| 196 | SP 53 : 1992 | Hand operated hand tools – Safety code for the use, care and protection |

**Electrical and Electronics.**

| | | |
|---|---|---|
| 197 | IS 732 : 1989 | Code of practice for electrical wiring installations |
| 198 | IS 2148 : 2004 | Electrical apparatus for explosive gas atmosphere – flameproof enclosures |
| 199 | IS 2309 : 1989 | Code of practice for the protection of buildings and allied structures against lightning. |
| 200 | IS 2551 : 1982 | Danger notice plates |
| 201 | IS 3043 : 1987 | Code of practice for earthing. |
| 202 | IS 4051 : 1967 | Code of practice for installation and maintenance of electrical equipments in mines. |
| 203 | IS 4691 : 1985 | Degrees of protection provided by enclosure for rotating electrical machinery. |
| 204 | IS 5216 : 1982 Part I | Recommendations on safety procedures and practices in electrical work - General |
| 205 | IS 5216 : 1982 Part II | Recommendation on safety procedures and practices in electrical work – Life Saving Techniques |
| 206 | IS 5571 : 2000 | Guide for selection of electrical equipment for hazardous areas. |
| 207 | IS 5572 : 1994 | Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation. |
| 208 | IS 5780 : 2002 | Electrical apparatus for explosive gas atmospheres – Intrinsic safety “i” - specification |
| 209 | IS 6381 : 2004 | Electrical apparatus for explosive gas atmospheres – Increased safety “e” |
| 210 | IS 6539 : 1972 | Specification for intrinsically safe magneto telephones for use in hazardous atmospheres |
| 211 | IS 7577 : 1986 | Specification for Gas testing flame safety lamps |
| 212 | IS 7689 : 1989 | Guide for control of undesirable static electricity |
| 213 | IS 7724 : 1975 | Specification for sand filled protection of electrical equipment for use in explosive atmospheres |
| 214 | IS 7689 : 1989 | Guide for the control of undesirable static electricity |

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|---|---|---|
| 215 | IS 7820 : 2004 | Electrical apparatus for explosive gas atmospheres – method of test for ignition temperature |
| 216 | IS 8239 : 1976 | Classification of maximum surface temperatures of electrical equipment for use in explosive atmospheres |
| 217 | IS 8241 : 1976 | Method of marking for identifying electrical equipment for explosive atmosphere. |
| 218 | IS 8607 : 1983 Part 5 | General and safety requirements for electrical equipment used in medical practice – protection against explosion hazards. |
| 219 | IS 8923 : 1978 | Warning symbol for dangerous voltages |
| 220 | IS 8945 : 1987 | Electrical measuring instruments for explosive gas atmospheres |
| 221 | IS 9249 : 1979 Part 1 | Safety requirements for indicating and recording electrical measuring instruments and their accessories: common safety requirements for instruments. |
| 222 | IS 9249 : 1982 Part 2 | Safety requirements for indicating and recording electrical measuring instruments and their accessories: safety requirements for instruments using a mains supply. |
| 223 | IS 9835 : 2001 | Series Capacitors for power systems – General performance, testing and rating – safety requirements – guide for installation. |
| 224 | IS 11000 : 1988 Part 1 | Fire hazard testing : Guidance for the preparation of requirements and test specifications for assessing fire hazard of electronic and electrical items, Sec 1 – General guidance |
| 225 | IS 11005 : 1984 | Dust tight ignition proof enclosures of electrical equipment |
| 226 | IS 11713 : 1986 Part 1 | Guide for physical planning of computer complexes :- Layouts |
| 227 | IS 11743 : 1986 | Guide on human safety in design, manufacture, use and maintenance of electronic equipment |
| 228 | IS 13925 : 1998 Part 1 | Shunt capacitors for ac power systems having a rated voltage above 1000 V – general performance, testing and rating safety requirements – guide for installation and operation. |
| 229 | IS 13947:Part 5: Sec 2 | Low voltage switch gear and control gear – specification – control circuit 2004 devices and switching elements – section 2 : Proximity switches |
| 230 | IS 14231 : 1995 Part 1 | Cabled distribution systems for television and sound signals – specification – safety requirements |
| 231 | IS 14989:2001 | Recommended practices for Seismic qualification of electrical equipment of the safety system for nuclear generating stations |
| 232 | IS 15111 : 2002 Part 1 | Self Ballasted Lamps for general lighting services – safety requirements |
| 233 | IS 15451 : 2004 | Electrical apparatus for explosive gas atmospheres |

**Material storage & handling.**

| | | |
|---|---|---|
| 234 | IS 1260 Part 1 | Code of practice for pictorial markings for handling and labeling of dangerous goods. |
| 235 | IS 1446 : 2002 | Classification of dangerous goods |
| 236 | IS : 9964 : 1981 Part 1 | Recommendations for maintenance and operation of petroleum storage tanks- Preparation of tank for safe entry and work |

**Chemicals and other hazardous materials.**

| | | |
|---|---|---|
| 237 | IS 1260 : 1973 Part 1 | Pictorial marking for handling and labeling of goods – Dangerous goods |
| 238 | IS 1446 : 2002 | Classification of dangerous goods |

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|---|---|---|
| 239 | IS 4155 : 1966 | Glossary of terms relating to chemical and radiation hazards and hazardous chemicals |
| 240 | IS 4209 : 1987 | Code of safety in chemical laboratories |
| 241 | IS 4263 : 1967 | Code of safety for chlorine |
| 242 | IS 11451 : 1986 | Recommendations for safety and health requirements relating to occupational exposure to asbestos |

# CHAPTER 89: CYBER SECURITY

Cyber Security plays an important role in the field of Information Technology. In the modern life style, without Information Technology, it will be almost paralyzed. Today, everything is possible to get information through information technology. Side by side, securing the information have become one of the biggest challenges in the present day. Whenever we think about the Cyber Security, one thing comes to our mind about "Cyber Crime" which are increasing immensely day by day. To provide some information regarding "Cyber Security" this Chapter is incorporated in the 'SAFETY MANUAL OF NEEPCO'.

Before entering in to Cyber Security, we should have some ideas about Cyber Threats.

Cyber Threats refer to a potential cyber-attack that aims to gain unauthorized access, disrupt, steal or damage IT access, computer network, intellectual property or any form of other sensitive data.

Types of Cyber Threats: -

A) Cybercrime: - It is a criminal activity that either targets or uses a computer, computer network or a network device.
B) Cyberterrorism: - It is defined as any premeditated attack against information systems, programmes and data that threatens violence or results in violence.
C) Cyberattack: - It is an attempt by hackers to damage or destroy IT Network or system. Some example of Cyberattack are: -

i) WEB ATTACK: - It affect the computer via the internet. These viruses can be downloaded from the internet and end up causing large scale and irreversible damages to the system.

ii) SQL INJECTIONS: - It effectively employs malicious codes and manipulates backend databases to access information that is not intended to be displayed. It has long term devastating effect such as deletion of tables, unauthorized viewing of any user list and even administrative access to databases.

iii) PASSWORD ATTACKS: - It is simply meant to decrypt or even attempt to obtain a user's password with criminal intentions. Attackers can use Dictionary Attacks, Password Sniffers or even Cracking programmes for these types of attacks.

iv) PHISHING ATTACKS: - It is a Social Engineering attack that is used to steal precious data such as login credentials or credit card details as attackers pretend to be trusted individuals and trick victims into opening malicious links.

v) SPEAR PHISHING ATTACKS: - These attacks are aimed at specific organizations' data by individuals who desire unauthorized access. These hacks are not executed by any random attackers but by individuals who are trying to access specific information like trade secrets, military intelligence etc.

vi) WHALE PHISHING ATTACKS: - This type of Phishing generally attacks people with high profile dignitaries. Primarily it aims at stealing information as these individuals typically have unlimited access and are involved with sensitive data.

vii) MALWARE: - It is one of the most common cyber threats by which cybercriminal or hacker has created a malicious software to disrupt or damage a legitimate user's computer. Sometime it spread via an unsolicited email attachment or legitimate looking download.

viii) TROJAN HORSES: - It is a malicious software appears like a standard application but causes damage to data files once executed.

ix) RANSOMWARE: - It generally blocks victim's access to their own data and deletes the same if ransom is not paid.

x) PUPS: - It stand for Potentially Unwanted Programs. PUPs do not directly attack a computer system but it may invite cyber-attacks by changing the configurations/settings of a browser, search engine or a pre-downloaded app in the system. PUPs can do the following:

- They display a lot of ads.
- PUPs add toolbars to your browser that take up memory.
- Potentially unwanted programs collect personal information.

xi) CROSS - SITE SCRIPTING: - In this type of attack, the attackers send malicious scripts from websites. When a user visits such infected web page, the malicious code is executed on the user's browser and thereby they steal important information like username and password.

xii) DDOS ATTACKS: - Such type of attacks mainly targeted at web servers of high-profile organizations such as the government or trade firms. Such type of attacks aims at shutting down services or networks and making them inaccessible to the intended users.

xiii) INSIDER YHREATS: - In such type of attack, an insider will be using his or her authorised access, willingly or unwillingly to do harm to the department's mission, resources, personnel, facilities, information, equipment, network or system.

xiv) MAN-IN-THE-MIDDLE ATTACKS: - This type of attack occurs when attackers eavesdrop on the communication between two entities. This type of crime affects both the communicating parties as the attacker can do anything with the interpreted information.

xv) BRUTE-FORCE AND DICTIONARY NETWORK ATTACKS: - These are network attacks where attackers attempt directly to log into the user's accounts by checking and trying out different possible passwords until they find the correct ones.

xvi) EAVESDROPPING ATTACKS: - These attacks begin with the interception of network traffic. Such type of attacks also known as Sniffing or Snooping attacks. In these types of crime, individuals attempt to steal information from computers, smartphones or other devices receive or send.

xvii) DRIVE-BY ATTACKS: - Such type of attacks is used to spread malware through insecure websites. Hackers first look for websites with lesser security parameters and then plant malicious scripts in to PHP (Hypertext Pre-processor) or HTTP (Hypertext Transfer Protocol Secure) code onto one of the pages. The script can then directly install the malware onto the computer of anyone who visit the site.

xviii) AI-POWERED ATTACKS: - In such type of attack, hackers develop some software and trained some people to perform specific tasks. They can accomplish these tasks by teaching themselves about obstacles that can potentially hinder their progress. They can also hack many systems including autonomous drones and vehicles and convert them into potentially dangerous weapons.

xix) PING OF DEATH ATTACK: - It is a one kind of attack in which the attacker aims to disrupt a targeted machine by sending a packet larger than the maximum allowable size, causing the target machine to freeze or crash.

xx) TEARDROP ATTACK: - It is one type of attack that attempts to make a computer source unavailable by flooding a network. It is a form of attack that causes fragmentation in the general sequence of Internet Protocol (IP) packets and sends these fragmented packets to the victim's machine.

Cyber Security is the defending practice to protect an Organisation and its Employees and Assets like Servers, Computers, Mobile devices, Electronic systems, Networks, Data etc. from malicious attack. It is also known as Information Technology Security or Electronic Information Security.

Cyber Security is a wide field covering several disciplines, they are: -

1. Network Security: - Most of Cyber-attacks occur over the Network. To protect such attacks, Network Security solutions are designed to identify and block these attacks. These solutions include data and access control such as Data Loss Prevention (DLP), Identification and Access Management (IAM), Network Access Control (NAC), Next Generation Firewall (NGFW), Intrusion Prevention System (IPS), Next Gen Antivirus (NGAV), Content Disarm and Reconstruction (CDR), and Sandboxing etc.

2. Cloud Security: - A cloud security strategy includes cyber security solutions, policies, and services that help to protect an organization's entire cloud deployment like applications, data, infrastructure etc. In an organization increasingly adopt cloud computing, securing the cloud become a major priority.

3. Mobile Security: - Mobile devices such as tablets and smartphones have access to corporate data, exposing business to threats from malicious apps, phishing and Instant Messaging (IM) attacks. Mobile Security prevents these attacks and secures the operating systems and devices from rooting and jailbreaking.

4. Application Security: - It focus on software and devices free of threats. It provides successful security begins in the design stage, well before a program or device is deployed. Application Security also prevent bot attacks and stop any malicious interaction with applications and Application Programming Interfaces (APIs).

5. IoT Security: - Internet of Things (IoT) security provide security to the vulnerable devices which are inadvertently connected to the Internet for nefarious uses such as a pathway into a Corporate Network or for another bot in a global bot network. It protects these devices with discovery and classification of the connected devices, auto segmentation to control network activities and using IPS (Intrusion Prevention System) as a virtual patch to prevent exploits against vulnerable IoT devices.

6. Endpoint Security: - With endpoint security companies can secure end – user devices such as desktops and laptops with data and network security controls, advanced threat prevention such as anti – phishing and anti – ransomware and technologies that provide forensics such as Endpoint Detection and Response (EDR) solutions.

7. Zero Trust: - It takes a more granular approach to security by protecting individual resources through a combination of micro – segmentation, monitoring and enforcement of role – based access control.

## SOME CYBER SECURITY TIPS

A) Keep your Software Up to Date.
B) Keep your Hardware Up to Date.
C) Use Anti – Virus Protection & Firewall.
D) Use Strong Passwords & Password Management Tool.
E) Use Two – Factor or Multi – Factor Authentication.
F) Learn about Phishing Scams - be very suspicious of emails, phone calls and flyers.
G) Protect your Sensitive Personal Identifiable Information (PII).
H) Use your Mobile Devices Securely.
I) Backup your Data Regularly.
J) Don't use Public Wi-Fi.
K) Review your Online Accounts & Credit Reports Regularly for Changes.
L) Use a Virtual Private Network (VPN) to privatize your connections.
M) Disable Bluetooth when it is not in use.
N) Scan external storage devices for viruses.
O) Check links before you click.
P) Invest in Security upgrades.
Q) Avoid the "Secure Enough" mentality.

**Her are some Dos and Don'ts in the field of Cyber Security**: -

## DOS

1. Use strong and unique Password containing combination of upper & lower cases, numerals and special characters.
2. Use different passwords for different accounts.
3. Use hard to guess password or passphrases and keep your password or passphrases confidential.
4. Pay attention to phishing traps in email not to be a cyber victim.
5. Destroy information properly which are no longer use.
6. Be aware of your surrounding when printing, copying, faxing or discussing sensitive information.
7. Lock your computer and mobile phone when not in use.
8. Have a discussion with your child about the risks of online predators.
9. Use privacy settings on social media sites to restrict access to your personal information.
10. Use standard browsers and keep them updated with latest patches.
11. Contact your IT support staff/Admin website to verify if an application is required to install in your computer.
12. If you receive a suspicious email, report it to your IT department without delay.

# DON'TS

1. Don't share the password with others or write them down.
2. Don't leave sensitive information lying around the Office.
3. Don't post any private information such as date of birth, place of birth, mother/father's name, Bank A/C Number, debit/ credit card numbers etc.
4. Don't plug in portable devices without permission from your agency management. These devices may be compromised with code just waiting to launch as soon as you plug them into a computer.
5. Don't install unauthorized programs on your computer, malicious applications often pose as legitimate software.
6. Don't open mail or attachments from an unauthorized source.
7. Don't leave printout or portable media containing private information on your desk, lock them in a drawer to reduce the risk of unauthorized disclosure.
8. Don't click on links from an unknown or untrusted source in your mobile/ computer.
9. Don't leave devices unattended.
10. Don't respond to phone calls or emails requesting confidential data.

**Remember – Cyber Security is everyone's responsibility.**

**Annexure – I (A)**

**NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED**

**(A GOVT OF INDIA ENTERPRISE)**

**Monthly Departmental Report of Accident (For internal use only)**

**Name of Project:-** **Period:-**

**Address of Project:-**

| Sl. No. | Date and Time of accident | Details of Affected Person | | | | | Cause of Accident | | | Nature of Duty/ Job | Length of service in particular Job | Posture of employee for particular Job | Name of Eye Witness if any | Division or Dept. | Name of Employer whether NEEPCO or other contractor or sub contractor | Expected disablement period | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Name and Address | Desig-nation | Age | Sax | Nature of Injury | Un-safe Act | Un-safe con-dition | Failure of Equipment | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| | | | | | | | | | | | | | | | | | |

Date :-

Signature
Name:-
Designation :-

Annexure – I (B)
NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED
(A GOVT OF INDIA ENTERPRISE)
Departmental Report of Near miss incident (For internal use only)

Name of Project :- Period:-
Address of Project:-

| Sl. No. | Date and time of Near miss incident | Location where Near miss occurs | Dept./Div. where it took place | Details of Near miss | | | | Preventive measures against recurrence | Remarks if any |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Brief description | Eye witness with their Name | Material/Equipment/ Personnel escape from incident | Reason of occurrence | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | | | | | | | | |

Date :-

Signature:-
Name:-
Designation:-

**Annexure – I (C)**

**NORTH EASTERN ELECTRIC POWER CORPORATION LIMITED**

**(A GOVT OF INDIA ENTERPRISE)**

**Monthly Departmental Report of Dangerous occurrence (For internal use only)**

**Name of Project:-** **Period:-**

**Address of Project:-**

| Sl. No. | Date and Time of Occu-rrence | Location of Occu-rrence | Nature of Occu-rrence | Dept./ Div. of Occu-rrence took place | Details of Equipment | | | | | | | | Apparent reason of the occurrence | Eye Witness | | Action if any to prevent recurrence | Re-marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Name of equip-ment | Name of Manu-facture | Purpose of use of equip-ment | Date of manu-factu-ring | Date of insta-llation | Date of last main-tenance | Date of last tested | Nature and extent of damage | | Name of Person | Brief description given by Eye Witness | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| | | | | | | | | | | | | | | | | | |

Date :-

Signature:-
Name:-
Designation:-

**Annexure II**

# INCIDENT INVESTIGATION REPORT

**Investigation Report No**……..…..... | Ref: Internal Incident no.....

**Incident title**: NM/FA/MI/DO/FT

## PART A

**Location:**

**Investigation Team:**

**Incident Date:**
**Time:**

**Investigation Initiated on:**

1. Description of Accident:

2. Details of Injured person(s) / fatality:

| Sr no | Name | Sex | Age | Employee / worker | Employee no. / gate pass no. | Nature of injury (NM / FA / MI / FT) |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |

3. List of Name of Witness and person interacted during the investigation:

4. Information from witnesses:

5. Part of body injured:

| Head | | | hands | | | Legs | | | trunk | | | others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eyes | head | Face | fingers | arms | shoulder | fingers | foot | other | chest | stomach | back | |
| | | | | | | | | | | | | |

6. Remarks (Name of Doctor, dispensary at which injured person gets First Aid treatment, details of First Aid provided etc):

7. Previous accident record of injured person:

8. Whether injured person at the time of accident wear proper PPEs:

9. Whether victim Person was trained on at site/ workplace for assigned the job:

10. Whether The injured person was under the influence of alcohol or drugs at the time of accident:

11. Is the injured person wilfully misuses any application or other things provided for securing health, safety of workers:

12. Whether the injured person wilfully disobeyed any order given or wilfully neglects to make use of appliances or other things provided for securing health, safety of workers in the industry:

## PART 2

13. Causes of Accident:

## PART 3

14. Remedial /corrective measures to reoccurrence of incident :

## PART 4

15. Action plan for remedial measures

| Sr no | Remedial actions / measures | Target date | Responsible person | Status (Closed / open) | Remark |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 . . . | | | | | |

## PART 5

16. Closing of Incident Investigation Report:

I/We hereby confirm that all remedial measures mentioned above by investigation team has been completed by the responsible person(s) within timeframe and hence this incident investigation report has been closed.

**Sign:**

**I/C (safety) NEEPCO**

**(in case of Nearmiss / first aid case Accident )**

**Sign:**

**Investigating team**

**Sign:**

**Factory Manager / HOP / Occupier**

**(in case of Major Injury Accident / dangerous occurrence / Fatality)**

**Annexure-III**

## PERMIT TO WORK AT HEIGHT

| PERMIT NO. | | |
|---|---|---|
| **1. SITE DETAILS**<br>Date of Issue _<br>Site Location: _ | | Record No.: |

**2. SAFETY PRECAUTIONS REQUIRED TO BE FULFILLED AT SITE**

| Sr | Safety Measures to be followed | YES | NO | NA |
|---|---|---|---|---|
| 1 | Whether all work at Height equipments & tools / tackles are available at site & whether they are previously inspected by concern person & found safe to use? | | | |
| 2 | Whether Area at ground level is cordoned off with rigid / chain link / fencing, so that no unauthorized people can enter the site? | | | |
| 3 | Whether safety net is provided under working site to protect fall of person(s)? | | | |
| 4 | Whether visual inspections of the WAH system & equipments are carried out prior to start of work. (Remove the equipment from site if any defect is found) | | | |
| 5 | Whether two lines of safety (i.e. safety harness with lanyards and fall arrestor) are provided & both lines of safety are attached firmly to separate fixed / rigid structures? | | | |
| 6 | Whether appropriate PPEs are available & used by site persons - (a) Full Body Safety Harness with lanyards (b) Fall arrestor (c) Hard Hat (d) Safety goggles (e) Safety Shoes (f) hand Gloves etc. | | | |
| 7 | Whether Safety instruction boards & signages has been displayed at site (No Smoking, Work in progress, restricted area, Sorry for Inconvenience, Emergency contact numbers etc) | | | |
| 8 | Whether workers & Supervisor are trained & experienced in working at height? | | | |
| 9 | Whether workers have undergone height pass test & whether they have passed height pass test? | | | |
| 10 | Whether workers are having problems like vertigo, epilepsy etc. which may cause dangerous to worker(s) during working at height? | | | |
| 11 | In case of hot job at height whether it is ensured that no combustible / flammable material is available under the job location? | | | |
| 12 | Whether Scaffold is erected as per the standard? (base plate, sole plate, cross bracings, proper & adequate means of access etc.) | | | |
| 13 | Whether Scaffold is inspected by competent officer & provided **GREEN TAG** indicating safe to use? | | | |
| 14 | Whether safe platform (with ladder, toe guard, handrails, rigid platform etc) provided to worker to protect against fall from height? | | | |
| 15 | Whether Hazard Identification & Risk Assessment (HIRA) is carried out for the job site & record is maintained? | | | |
| 16 | Whether Fire extinguisher with valid testing/refilling dates is available on site. | | | |
| 17 | Whether First aid box in replenished condition is available at site? | | | |
| 18 | Whether Tool Box Talk has been conducted before commencement of work & record is maintained? | | | |

**3. Permit Authorising person**

Additional precautions if any required to be complied to complete the job safely:

1.

2.

3.

I have explained the safety & technical requirement for the above work to the permit receiver. I am issuing the permit to the permit receiver for the above work with subject to the fulfillment of the above mentioned safety precautions at working site /area.

| Job to be started | | Job to be completed | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | | |
| | | | | | | | |

**4. Acknowledgement by safety department**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained Safety Precautions / requirements mentioned above & advised to carry out the above work after the fulfillment of all safety precautions.

| Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|
| | | | |

**5. Permit Receiver (Site / O & M plant Engineer to be present at site)**

I have understood the Safety & Technical requirement for above job. The site has been examined by myself in compliance to the above requirements and Tool Box Talk is conducted. Based on the same I herewith receive the permit for carrying out the above job. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work.

| Job start | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|
| Date | Time | | | | |
| | | | | | |

**6. Work extension (to be taken by permit receiver)**

During each extension of work I have reviewed the site and ensured that all safety requirements mentioned above has been provided. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before & during the work. I have informed the permit authorizing person & safety department before commencing the extension job of above permit.

| Job Extended From | | Job Extended To | | Sign of authorizing person with date & time | Sign of safety department with date & time | Sign of permit receiver with date & time |
|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**7. Work completion and permit closing:**

The above work has been completed in safety; hence this permit may be closed.

| Work completed | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|
| Date | Time | | | |
| | | | | |

On completion of the work, copy of this permit must be returned to the Authorised Person.

***Note: This work permit is valid only for the above mentioned site and it may be changed as per the requirements projects/ Plant***

**Annexure-IV**

## PERMIT FOR CONFINED SPACE ENTRY

**Applicable for Deep Trench (>2m), Tanks / Vessel / Chamber Entry**

PERMIT NO.

**1. SITE DETAILS**

Date of Issue _

Site Location: _

Record No.:

**2. SAFETY PRECAUTIONS REQUIRED TO BE FULFILLED AT SITE**

| Sr.No. | Description | YES | No | NA |
|---|---|---|---|---|
| 1. | Whether all confined space work equipments & tools / tackles are available at site & whether they are previously inspected by concern person & found safe to use? | | | |
| 2. | Whether workers & Supervisor are trained & experienced in confined space? | | | |
| 3. | Whether workers are briefed about risk in the job & precaution required to be followed during working in confined space. | | | |
| 4. | Whether Hazard Identification & Risk Assessment (HIRA) has been carried out for the job site & record is maintained? | | | |
| 5 | Is the confined space is free from combustible / flammable toxic fumes and dust before entering and working into it? | | | |
| 6. | Is the confined space area kept open for more than 15 min before entering? | | | |
| 7. | Is air blower available to maintain continuous supply fresh air and to maintain oxygen level for breathing? | | | |
| 8. | Is ladder/tripod provided for the person entering the confined space? | | | |
| 9. | Is person entering in the confined space wearing safety belt with lifeline attached to tripod? | | | |
| 10. | Whether standby workers are available to hold lifeline and to have communication with the person entering into the confined space? | | | |
| 11. | Is proper trench support i.e. shoring / shuttering / bottom support provided in case of deep trench, loose soil condition or in case of chances of trench collapse etc.? | | | |
| 12. | Is fire extinguisher, made available at site is in good condition within all due dates? | | | |
| 13. | Is all the applicable PPE worn by the personnels at site? Breathing apparatus must be worn by the person entering the confined space it $O_2$ level goes below 18% v/v. | | | |
| 14. | Is the first aid box made available at site with all medicines & list of medicines in it? | | | |
| 15. | Whether Cleaning is carried out & proper lighting (flameproof light- 24 volt) is provided prior to entry inside the confined space? | | | |
| 16 | Whether Tool Box Talk has been conducted before commencement of work & record is maintained? | | | |
| 17 | Whether emergency contact nos. has been displayed at site? | | | |

Oxygen Monitoring:

| | Test required | Safe limit | Actual reading | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Oxygen | Yes / No | | | | | | | | | |

Note: Oxygen level Reading of confined space shall be taken in every 20 mins interval

**3. Permit Authorising person**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained the safety & technical requirement for above work to the permit receiver. I am issuing the permit to the permit receiver for the above work with subject to the fulfillment of the above mentioned safety precautions at working site / area.

| Job to be started | | Job to be completed | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | | |
| | | | | | | | |

**4. Acknowledgement by safety department**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained Safety Precautions / requirements mentioned above and advised to carry out the above work after the fulfillment of all safety precautions.

| Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|
| | | | |

**5. Permit Receiver (Site / O & M plant Engineer to be present at site)**

I have understood the Safety & Technical requirements for above job. The site has been examined by myself in compliance to the above requirements and Tool Box Talk has been conducted and also explained the hazards and risk involved in the job and measures to be taken to all workers involved in the job. Based on the same I herewith received the permit for carrying out the above job. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work.

| Job start | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|
| Date | Time | | | | |
| | | | | | |

**6. Work extension (to be taken by permit receiver)**

During each extension of work I have reviewed the site and ensured that all safety requirements mentioned above has been provided. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work. I have informed the permit authorizing person and safety department before commencing the extension job of above permit.

| Job Extended From | | Job Extended To | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**7. Work completion and permit closing:**

The above work has been completed safely; hence this permit may be closed.

| Work completed | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|
| Date | Time | | | |
| | | | | |

On completion of the work, copy of this permit must be returned to the Authorised Person.

***Note: This work permit is valid only for the above mentioned site and it may be changed as per the requirements projects/ Plant***

**Annexure-V**

# WORK PERMIT - HOT WORK

PERMIT NO.

**1. SITE DETAILS**
Date of Issue _
Site Location: _

Record No.:

**2. SAFETY PRECAUTIONS REQUIRED TO BE FULFILLED AT SITE**

| Sr no | Item | Yes | No | NA |
|---|---|---|---|---|
| 1 | Whether required PPEs (helmet, safety shoes, apron, face shield, safety goggle, hand gloves etc) worn by the engaged workers? | | | |
| 2 | Whether all work equipments / machines & tools / tackles are available at site & whether they are previously inspected by concern person & found safe to use? | | | |
| 3 | Whether workers & Supervisor are trained & experienced in confined space? | | | |
| 4 | Whether workers are briefed about risk in the job & precaution required to be followed during job. | | | |
| 5 | Whether it is ensured that no combustible / flammable material / dust / fumes are available at / nearby / under the job location? | | | |
| 6 | Whether adequate fire fighting arrangements made available at site / job location? | | | |
| 7 | Is the first aid box made available at site with all medicines & list of medicines in it? | | | |
| 8 | Proper ventilation & lighting (flameproof light- 24 volt) is provided? | | | |
| 9 | Whether Tool Box Talk has been conducted before commencement of work & record is maintained? | | | |
| 10 | Whether emergency contact nos., Safety instruction boards & signages have been displayed at site? | | | |
| 11 | Whether Hazard Identification & Risk Assessment (HIRA) has been carried out for the job site & record is maintained? | | | |
| 12 | Whether Area is cordoned off & Precautionary tags / Boards provided to restrict unathorised entry? | | | |
| 13 | Proper means of exit / escape provided? | | | |
| 14 | Whether Spark Arrestor on the mobile equipment / vehicle provided? | | | |
| | | | | |
| | **Welding (additional requirements)** | | | |
| | Whether earth connection provided properly? | | | |
| | Whether welding wires are without open joints? | | | |
| | | | | |
| | **Gas cutting (additional requirements)** | | | |
| | Whether gas cylinders are kept upright position & fixed to rigid structure by chain / chained in the trolley? | | | |
| | Whether flash back arrestors provided on both sides of both hoses i.e. at torch end & valve end? | | | |

**3. Permit Authorising person**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained the safety & technical requirement for above work to the permit receiver. I am issuing the permit to the permit receiver for the above work with subject to the fulfillment of the above mentioned safety precautions at working site / area.

| Job to be started | | Job to be completed | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | | |
| | | | | | | | |

**4. Acknowledgement by safety department**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained Safety Precautions / requirements mentioned above and advised to carry out the work after the fulfillment of all safety precautions.

| Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|
| | | | |

**5. Permit Receiver (Site / O & M plant Engineer to be present at site)**

I have understood the Safety & Technical requirements for above job. The site has been examined by myself in compliance to the above requirements and Tool Box Talk has been conducted and also explained the hazards and risk involved in the job and measures to be taken to all workers involved in the job. Based on the same I herewith received the permit for carrying out the above job. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work.

| Job start | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|
| Date | Time | | | | |
| | | | | | |

**6. Work extension (to be taken by permit receiver)**

During each extension of work I have reviewed the site and ensured that all safety requirements mentioned above has been provided. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work. I have informed the permit authorizing person and safety department before commencing the extension job of above permit.

| Job Extended From | | Job Extended To | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**7. Work completion and permit closing:**

The above work has been completed safely; hence this permit may be closed.

| Work completed | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|
| Date | Time | | | |
| | | | | |

On completion of the work, copy of this permit must be returned to the Authorised Person.

***Note: This work permit is valid only for the above mentioned site and it may be changed as per the requirements projects/ Plant***

**Annexure-VI**

# WORK PERMIT - EXCAVATION

PERMIT NO.

**1. SITE DETAILS**

Date of Issue _

Site Location: _

Record No.:

**2. SAFETY PRECAUTIONS REQUIRED TO BE FULFILLED AT SITE**

| Sr | Item | Yes | No | NA |
|---|---|---|---|---|
| 1 | Whether all work equipments / machines & tools / tackles are available at site & whether they are previously inspected by concern person & found safe to use? | | | |
| 2 | Whether Underground utilities are identified by Trial pit / Cable location survey, marked on ground and are isolated, if possible. Trial pit & Cable location Survey record is available at site. | | | |
| 3 | Whether Excavated soil is stored 500 mm away from the edge of the trench/pit | | | |
| 4 | Whether workers & Supervisor are trained & experienced in excavation work? | | | |
| **5** | Whether hard barricading provided around the trench & Safety Signages tags / Boards provided to restrict unathorised entry? | | | |
| **6** | Whether workers are briefed about risk in the job & precaution required to be followed during job. | | | |
| **7** | Whether adequate fire fighting arrangements made available at site / job location? | | | |
| **8** | Is the first aid box made available at site with all medicines & list of medicines in it? | | | |
| **9** | Whether Hazard Identification & Risk Assessment (HIRA) has been carried out for the job site & record is maintained? | | | |
| 10 | Whether Tool Box Talk has been conducted before commencement of work & record is maintained? | | | |
| 11 | Whether emergency contact nos., Safety instruction boards & signages have been displayed at site? | | | |
| 12 | Whether Proper means of exit / escape provided? | | | |
| 13 | Whether adequate ventilation & lighting has been provided? | | | |
| 14 | Whether required PPEs (helmet, safety shoes, safety goggle, hand gloves etc) worn by the engaged workers? | | | |
| 15 | Whether Heavy equipment's are kept 1 m away from the trench edge & barricaded? | | | |
| 16 | Whether Trench protection by shoring/shuttering is provided for trench more than 2 mtr depth? | | | |
| | **If RCC Breaker is used** | | | |
| 17 | Whether Concrete breaker operator with 11KV hand gloves, safety Shoes, earplug, Helmet etc? | | | |
| 18 | Whether Whip check slings are provided for each joint of compressor and breaker? | | | |
| 19 | Whether Nearby workers with ear plug? | | | |
| 20 | Whether Condition of equipment are checked for loose fittings of drill, drill condition, handle etc.? | | | |
| 21 | Whether Statutory Form of Pressure Vessel required for compressor is available at site? | | | |
| | **If Mechanical excavation/ Excavator is used** | | | |
| 22 | Whether Operation is carried out within barricade? | | | |
| 23 | Whether No Simultaneous operations are carried out inside trench? | | | |
| 24 | Whether Condition of equipments are checked for oil leakage, breaks, mirrors, lamp, excavator boom etc.? | | | |
| 25 | Whether Excavator operators are trained and having valid license? | | | |
| 26 | Whether Fitness certificate is available for Excavator? | | | |
| 27 | Whether measures against has been taken for site specific hazards like overhead Cables / Electrical Lines / Heavy Traffic etc.? | | | |
| | **If manual excavation :** | | | |
| 28 | Whether 3/4th portion of crowbar is insulated completely | | | |
| 29 | Whether cross over plate is provided at every 50 mts. interval.( Minimum 32 mm Thick Plywood ) | | | |
| 30 | Look for site specific hazards like overhead Cables / Electrical Lines / Heavy Traffic and control measures against each are available at site | | | |
| 31 | Visual Inspection of the excavation area is done for other facilities (cable, electrical, water), sources of ignition, barricades etc. | | | |
| 32 | Whether emergency response plan with roles and responsibilities has been defined? | | | |

**3. Permit Authorising person**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained the safety & technical requirement for above work to the permit receiver. I am issuing the permit to the permit receiver for the above work with subject to the fulfillment of the above mentioned safety precautions at working site / area.

| Job to be started | | Job to be completed | | Name | Designation | Sign with date & time | Contact No. |
|---|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | | |
| | | | | | | | |

**4. Acknowledgement by safety department**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained Safety Precautions / requirements mentioned above and advised to carry out the work after the fulfillment of all safety precautions.

| Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|
| | | | |

**5. Permit Receiver (Site / O & M plant Engineer to be present at site)**

I have understood the Safety & Technical requirements for above job. The site has been examined by myself in compliance to the above requirements and Tool Box Talk has been conducted and also explained the hazards and risk involved in the job and measures to be taken to all workers involved in the job. Based on the same I herewith received the permit for carrying out the above job. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work.

| Job start | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|
| Date | Time | | | | |
| | | | | | |

**6. Work extension (to be taken by permit receiver)**

During each extension of work I have reviewed the site and ensured that all safety requirements mentioned above has been provided. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work. I have informed the permit authorizing person and safety department before commencing the extension job of above permit.

| Job Extended From | | Job Extended To | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**7. Work completion and permit closing:**

The above work has been completed safely; hence this permit may be closed.

| Work completed | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|
| Date | Time | | | |
| | | | | |

On completion of the work, copy of this permit must be returned to the Authorised Person.

***Note: This work permit is valid only for the above mentioned site and it may be changed as per the requirements projects/ Plant***

**Annexure VII**

# ELECTRICAL WORK PERMIT (ENERGY ISOLATION)

| PERMIT NO. | | |
|---|---|---|
| **1. SITE DETAILS**<br>Date of Issue _<br>Site Location: _ | | Record No.: |

**2. SAFETY PRECAUTIONS REQUIRED TO BE FULFILLED AT SITE**

| Sr no | Item | Yes | No | NA |
|---|---|---|---|---|
| 1 | Whether HT/LT breaker(s) is/are racked out/kept off? | | | |
| 2 | Whether Power fuse and Counter fuse are removed? | | | |
| 3 | Whether Grounding is done? | | | |
| 4 | Whether permission taken from transmission authority in case of switch yard work or overhead line work? | | | |
| 5 | Whether Caution Notices are affixed in all switch boards? Whether emergency contact nos., Safety instruction boards & signages have been displayed at site? | | | |
| 6 | Whether lock and tag are provided for disconnecting electrical equipments? | | | |
| 7 | Whether required PPEs (helmet, safety shoes, apron / suit, safety goggle, rubber hand gloves etc) worn by the authorised engaged workers / electricians? | | | |
| 8 | Whether all work equipments / machines & tools / tackles are available at site & whether they are previously inspected by concern person & found safe to use? | | | |
| 9 | Whether workers, Supervisor & electricians are trained, experienced and authorized for doing work on electrical lines? | | | |
| 10 | Whether worker / electricians are trained in shock treatment? | | | |
| 11 | Whether workers are briefed in tool box talk about risk in the job & precaution required to be followed during job & record is maintained? | | | |
| 12 | Whether adequate fire fighting arrangements and replenished first aid box made available at site/ job location? | | | |
| 13 | Whether Hazard Identification & Risk Assessment (HIRA) has been carried out for the job site & record is maintained? | | | |
| 14 | Whether Area is cordoned off and Precautionary tags / Boards provided to restrict unathorised entry? | | | |
| 15 | Whether Proper means of exit / escape provided? | | | |

**3. Permit Authorising person**

Additional precautions if any required to be complied to complete the job safely:

1.
2.
3.

I have explained the safety & technical requirement for confined space entry to the permit receiver. I am issuing the permit to the permit receiver for the above work with subject to the fulfillment of the above mentioned safety precautions at working site / area.

| Job to be started | | Job to be completed | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | | |
| | | | | | | | |

**4. Acknowledgement by safety department**

Additional precautions if any required to be complied to complete the job safely:

1.

2.

3.

I have explained Safety Precautions / requirements mentioned above and advised to carry out the work after the fulfillment of all safety precautions.

| Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|
| | | | |

**5. Permit Receiver (Site / O & M plant Engineer to be present at site)**

I have understood the Safety & Technical requirements for above job. The site has been examined by myself in compliance to the above requirements and Tool Box Talk has been conducted and also explained the hazards and risk involved in the job and measures to be taken to all workers involved in the job. Based on the same I herewith received the permit for carrying out the above job. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work.

| Job start | | Name | Designation | Signature with date & time | Contact No. |
|---|---|---|---|---|---|
| Date | Time | | | | |
| | | | | | |

**6. Work extension (to be taken by permit receiver)**

During each extension of work I have reviewed the site and ensured that all safety requirements mentioned above has been provided. I shall be available at site for the entire duration of the job and I take the responsibility to ensure all safety measures at working site /area are in order before and during the work. I have informed the permit authorizing person and safety department before commencing the extension job of above permit.

| Job Extended From | | Job Extended To | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|---|---|
| Date | Time | Date | Time | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**7. Work completion and permit closing:**

The above work has been completed safely; hence this permit may be closed.

| Work completed | | Sign of permit receiver with date & time | Sign of safety department with date & time | Sign of authorizing person with date & time |
|---|---|---|---|---|
| Date | Time | | | |
| | | | | |

On completion of the work, copy of this permit must be returned to the Authorised Person.

***Note: This work permit is valid only for the above mentioned site and it may be changed as per the requirements projects/ Plant***

**Annexure VIII**

**FORMAT FOR FIRE ORDER**

**STANDING FIRE ORDERS FOR _____**

(**Emergency Plan for Fire/Explosion**)

(i) Brief description of plant/ building

(ii) Hazards Associated with Plant/ building

(iii) Available Fire Fighting Measures

(i) Portable systems

(ii) Fixed systems

(iv) Emergency Conditions (Probable)

Emergency condition may arise due to the following:
Such an emergency will have to be dealt with utmost speed and efficiency in order to avoid casualties and minimize damage to property. It is therefore, necessary that all the activities of the staff should be governed by certain set of rules on the principles and practices of Fire Fighting and Salvage Operations.

This set of rules shall be termed as 'STANDING FIRE ORDERS FOR _____' and will take into account other emergency conditions also.

**1.1 Emergency Control Room**

Location of control room

Internal telephone numbers

Direct telephone numbers

**1.2 Fire Station**
Fire station phone numbers

Fire station office phone numbers

Direct telephone numbers

Neighborhood fire station phone numbers

**1.3 Areas and Duty Officers**

For easy and quick action and co-ordination in an emergency, divide the site in to areas and list them as Annexure-I

**1.4 Manned Areas and Unmanned Areas**

General shift (working days) senior most person in area

Other shift/Holidays shift-in-charge of area

For an area not functioning at the time of the incident, security officer should act in the absence of area officer.

List the name of areas for which security officer to act in the absence of area Officer.

List the duty officers of various areas in Annexure-I

List the duties of duty officer

Each area shall have a duty officer designated by plant.

**2 Duties**

Duties of various officers/groups concerned are detailed below:

**2.1 By Person(s) who detects fire**

**2.2 Duty Officer**

List out the general duties

**2.2.1 List the action of duty officer in case of fire**

By Duty Officer of other areas

By officer of emergency control room

By Telephone operator

By Fire squads

By Plant manager

By Fire officer (fire service)

By Medical officer

By utility services

By power distribution

By transport services

By in-charge of Safety

By Security

## HISTORY CARD OF REVISION OF SAFETY MANUAL

| Sr | Revision no. | Revision date | Remark |
|---|---|---|---|
| 1 | Rev No. 01 | 05.01.2018 | Done by Fire & Safety Wing, NEEPCO Ltd., Shillong as recommended by Technical Safety Committee. |
| 2 | Rev No. 02 | 15.05.2023 | In this revision one new chapter, Chapter: 89, Cyber Security has been incorporated, hence it is checked by The DGM (IT). Some minor changes have been done in few places. |
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