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Unit-1 Safety & Prevention of Accidents.

* Defination of Terminology used in safety :-

1) **Safety :-** The meaning of term safety is being safe, not being dangerous or in danger. Following safety practices are to be followed:
   i) Place yourself and secure position to avoid slipping, stubling or moving backward against live conductors or apparatus
   ii) In the event of near approach of lightning storm, all outdoor work in electrical system should be stopped.
   iii) Make a habit of being cattious. Be on the lookout for danger notice plates, danger flags, warning boards and signals etc. Warn others when they seems to be in danger near live conductors or apparatus.

2) **Hazard :-** The things that arise without planning or random:
   i) In electrical system, it is quite possible that fault may develop haphazardly causing the disturbance in the system.
   ii) Whenever there is breakdown of insulation over the wires because of generation of heat & resulting fire hazards from electricity

3) Accidents :- The event that happen unexpectedly and causes damage or injury is called as accident.

4) Major Accident Hazard :- The major accident hazard is that the person coming in contact with machinery, equipment, apparatus gets severe shock, which may cause the death of the person. This will happen if there is a faulty earth or no insulation of circuit.

5) Responsibility :- The responsibility means being responsible or accountable. It is the responsibility of incharge engineer to see that plant operation goes on smoothly.

Whenever breakdown are taken, the shutdown and charging of lines should not be carried out without permit to work to a person by authorized person, otherwise if anything goes wrong, incharge engineer is responsible for that.

6) Authority :- The person who has the powers to give orders and makes others to obey the same is called authority.

7) Accountability :- It is expected from person incharge of certain work to give an explaination if something goes wrong or if the work is not completed in specific period. It means it is accountability of a particular officer to do the work within specified time.

8) Monitoring :- Monitoring is the process in which contineous observations of record or test of operation of machine or equipment are carried out.

A chief engineer in a generating plant monitors all the operations in the plant. By monitoring, he is able to know working of turbine, boiler, generator and other plant equipments.

* I.E. Act and statutory Regulations for safety of person and Equipment working with Electrical Installation :-

Some special instructions to provide safe working condition shall be followed by all persons, all the times. If anyone disregarding these instructions should be properly punished.

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

2) The person incharge shall explain the nature and duration of work to be carried out to permit issuing authority and obtain from him a permit to work before commencing any work.

3) The permit issuing authority shall not issue a permit unless :

a) switches have been withdrawn and completely isolated on both sides; link and fuses opened,

mains and apparatus discharged and earth & all adjacent live parts are protected. Switches and fuses of all control panels shall also be rendered inoperative.

b) Danger notice plates in conspicuous place on mains and apparatus.

c) An entry is made in log-book or log-sheet.

4) A person incharge, before allowing any workman to commence work on the mains and apparatus, shall take the following precautions:

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

b) Ensure that switches controlling the mains & apparatus have been isolated, discharged, properly earthed.

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

5) Where work is to be carried out on live low or medium voltage mains or apparatus. Some additinal instructions shall be complied with:-

a) No work shall be carried out by any person without rubber gloves and other approved equipment for protection against electric shock.

b) When person is working on live mains, he should be accompanied by second person who is capable of rendering first-aid & artificial respiration.

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c) The person incharge shall examine the safety equipment before use.

6) On completion of the work, remove all earthing devices, so that the mains and apparatus are fit in all respect for charging.

7) All accidents shall be immediately attended to and reported to proper authorities. In the event of serious accident involving danger to life, incharge shall immediately get a doctor on site or remove the victim being certified dead by a doctor, the body should not be removed without the permission of police.

8) These instructions shall be readout and explained to workmen in their language & copies shall be displayed on various notice boards. Ignorance of instructions shall not be accepted as an excuse for non-compliance with them.

* Dos & don'ts for substation operator as listed in IS :-

Do	Don't
1) Place sign 'Men working' or other warning boards on main switch before commencing work.	Do not close any switch, unless you are familiar with the circuit & reason for its being opened.
2) Before working on any circuit make sure that all switches are opened and locked or remove the fuse holders.	Do not touch or tamper to any electrical gear or conductor unless you have made sure that it is dead or earthed. High vtg apparatus may give leakage shock or flash even without touching.
3) Always treat the ckt as alive until you have proved to be dead, the insulation may be defective	Do not work in live ckt without express order of incharge person & take second person for first-aid & artificial respiration.
4) Cultivate habit of turning your face away whenever arc or flash may occur.	Do not disconnect earthing connection unless safety gadgets installed on mains & apparatus.
5) Guard against arcs as well as high voltages because burn from arc is severe.	Do not tamper with meter board & cut outs without permit.

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6) See all the splices and connections are securely made.	Do not expose your eye to electric arc, it gives painful injury.
7) Test rubber gloves periodically.	Do not use metal case flash light around device which is energized.
8) Place rubber mats infront of electric switch boards.	Do not place your body in ckt when making the connections.
9) Prevent accumulation of gases in unventilated manhole.	Do not use wires with poor insulation. Do not touch electric ckt when your hands are wet.
10) Take great care while breaking inductive circuit as dangerously high vtg is likely to result.	Do not close or open a switch or fuse slowly or hesitatingly, do it quickly & positively.

* Meaning and causes of Electrical Accidents :-

- Electrical accident can be defined as a case where a person receives directly or indirectly either from a generating system, transmission system or distribution system of electrical energy.

- If a person working on electric pole for repair and falls down causing him injury can be considered under electrical accidents. Most accidents are due to carelessness & result in fall, fire or electric shock.

Causes of Electrical Accidents :-

1) If a person touches the live wire or current carrying parts.
2) If metal frame (body) of machine get becomes live due to some fault.
3) If high vtg wdg in transformer, shorts to its LV wdg, which may puncture the insulation bet^n LV and core.
4) Because of electric spark or arc, electrical equipment gets overheated.
5) Due to loose jumper having contact with live wire.
6) Electrical accident may takes place due to insulation failure of wire or cable connecting electrical machines.
7) In some cases walls of building remains always wet, causes leakage of electric current & fatal accidents.

8) Operation of switches with wet hand may result into accident.
9) In case of electric fire, if water source is used for quenching or keeping contact with electric installation may result in fire.
10) A line-man working on pole which is fed from two sides may fall in accident if he exactly don't know source of side & their switches

Factors on which severity of shock Depends:-

- It is mainly depends upon voltage of the system and current passing through the body.
- It is also depends upon the period for which contact bet? live part and body.
- It also depends upon the supply system whether a.c. or d.c.
- It is also depends upon the resistance of body.
- Body resistance mainly consist of skin resistance will have the values 100kΩ to 500kΩ when it is dry.
- The effect of current on human system :-

current in mA	Effect on human body
1) 1-8	does not cause any pain.
2) 8-15	painful shock without loss of muscular control.
3) 15-20	painful shock, adjucent muscles lost.
4) 20-100	may result in instant death.
5) 200 & above	severe burn, muscular contraction, chest muscles clamp down the heart & stop it

* Procedure for Rescuing the person who have received an electric shock :-

1) General :-

a) In most cases of electric shock & collapse, the lungs and diaphram that stop working and there is very good chance of revival by applying quickly artificial respiration.

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

c) In all cases of electric shock where condition of patient is doubtful or not breathing or unconcious, artificial respiration should be continued until death is diagonised by physician.

2) Removal From the Contact :-

a) If the person still in contact with apparatus switch off the electric circuit. If it is not possible to switch off quickly, no time should be lost in removing the body

b) The victim's body should not be touched by bare hands, rubber gloves should be worn. If rubber gloves are not available the victim should be pulled off by his coat, shirt etc. If they are not wet or newspaper folded into 3 or more thickness. Wooden rod may be used

to detach the body from live conductor. A good plan is to stand on dry board or stool & by newspaper bundle remove the victim from live conductor.

3) Preliminary stages :-
If the patients clothes are smouldering, the spark should be first extinguished.

4) Immediate Action to recover the patient :-

a) When a man has received a severe electric shock, his breathing usually stops. In such a cases speed may save the life. No time should be wasted in sending to the doctor but patient should not be neglected during this period.

b) Patient should not be placed in such a position which may bring pressure on burns he may have sustained. He should not be exposed to cold stimulants unless recommended by a doctor.

c) Artificial respiration without interruption until natural breathing is restored. Cases are on record of success after about 3 to 4 hours effort even more.

d) Resuscitation should be carried on nearest possible place of accident. The patient should not be removed from this place until he is found breathing normally.

5) Up on Recovery :-

When patient revives, he should be kept lying down & not allowed to get up or be raised under any circumtances without advice of doctor. If doctor is not arrived by the time & patient revived, give him tea, coffee or drink of hot ginger.

6) First Aid Treatment :-

should be given to all the burns.

* Methods of artificial Respiration :-

1) Schafer's Prone Pressure Method :-

2) Silvester's Method (Arm-Lift chest pressure Method) :-

3) Arm-Lift Back Pressure Method :-
(Nielson's method)

4) Mouth-To-Mouth Method :-

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* Precautions to be taken to avoid fire due to Electric reason :-

1) The most important factor to avoid electric fire is to use proper rating of fuses and protective relays which are depends upon connected load.
2) Indian Electricity rules should be follows. The load on any ckt should not beyond the permissible limit. Circuit should not be overloaded.
3) A very good earthing should be provided to every equipment and machines.
4) A good quality insulating material should be provided on wires.
5) Other material used for connection should have good quality and fire resistant.
6) Joint of the wire are strong enough so that sparking is avoided.
7) Electrical installation should be free from moisture effect of chemical fumes, dirt, dust etc. It should not be carried out near water lines.
8) Fire fighting equipments, such as fire extinguishers, buckets filled with sand etc. should be kept ready at all times.

* Operation of fire extinguishers :-

- In the event of fire on electric mains or apparatus, the effected part immediately be isolated from its source of supply.
- fire extinguishers, which are not insulated, should never be employed in fighting fires near live exposed conductors. Only used on electrical mains and apparatus which are marked as suitable for the purpose.
- When using fire hose, it should be ensured that jet of water does not come into contact with live conductor.
- A CO_2 extinguisher offers the advantage of extinguishing the fire, cooling the apparatus, leaving no residue and no effect on insulation & metal parts & it may be used on live ckt. Hence it is preferred extinguishing agent for most electeical fires.
- When it is applied in confined spaces, such as engine room of ship, the CO_2 should be purged with air before workmen are allowed to entee.
- A Carbon Tetrachloride extinguisher will put out the fire and cool the apparatus, but excessive use of this agent will be detrimental to insulation and metal parts.
- Water sprinklers may be used after the ckt is de-energized. such systems are built into T/f & large machines.

POSITION 1

POSITION 2

POSITION 3

Fig. 1 Schafer's Method

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

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

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

2) Silvester's Method (Arm-Lift Chest-Pressure Method)—This method is illustrated in Fig. 2. The patient is laid on his back. His arms are grasped above the wrists and drawn first upward and then above the head until they touch the floor. Then they are brought back to the chest and pressure is exerted in a downward direction. The main defect of this method is that the tongue

which is a boneless mass of muscle, having lost its tone due to lack of respiration, tends to fall back and block the wind pipe in about 50 percent of the cases, causing a choke. So, a second operator has to pull out the tongue and hold it so. But, sometimes no second man may be available. If, however, a large thick pad is placed behind the shoulders, so that the head lies dangling downwards, the tongue does not seem to obstruct.

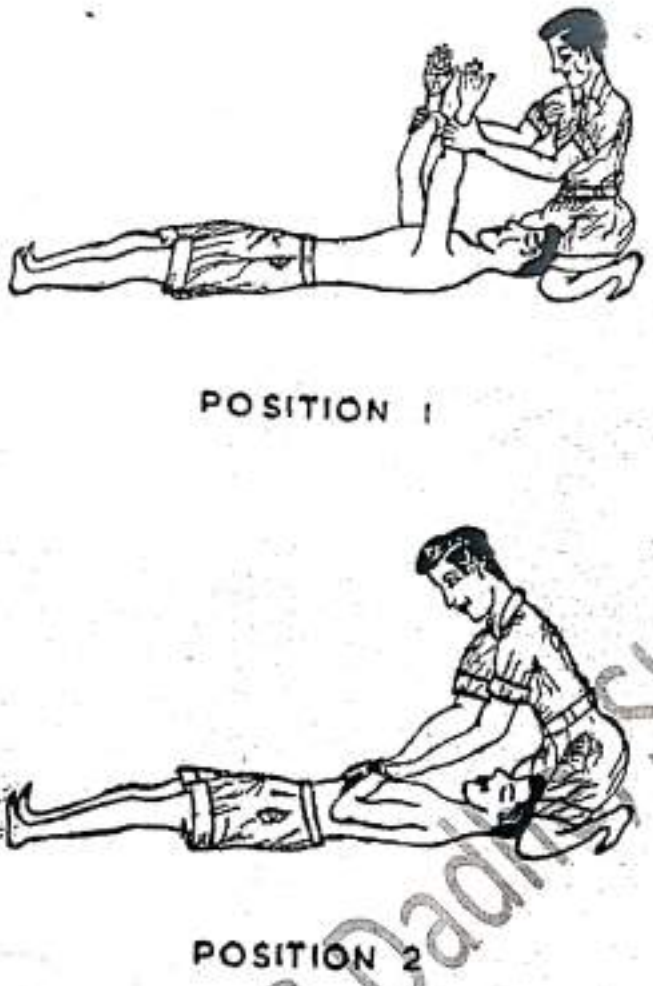

Fig. 2 Silvester's Method (Arm-Lift Chest-Pressure Method)

3) Arm-Lift Back Pressure Method

This is called Nielson's Method in Denmark and has been modified by Professor Drinker of USA. The modified method is illustrated in Fig. 3. The subject lies prone with both arms folded and hands resting, one on the other, under his head. The arms are grasped above the elbow and lifted until firm resistance is met. This induces active inspiration. Then they are let down and pressure applied on the back to cause active expiration.

The movements in this method follow the sequence given below:

a. *Position 1*—Place victim prone (that is, face down) with his arms folded with one palm on the other and head resting on his cheek over the palms. Kneel on one or both knee at victim's head. Place your hands on the victim's back beyond the line of armpits, with your fingers spread outwards and downwards, the thumbs just touching each other. 12

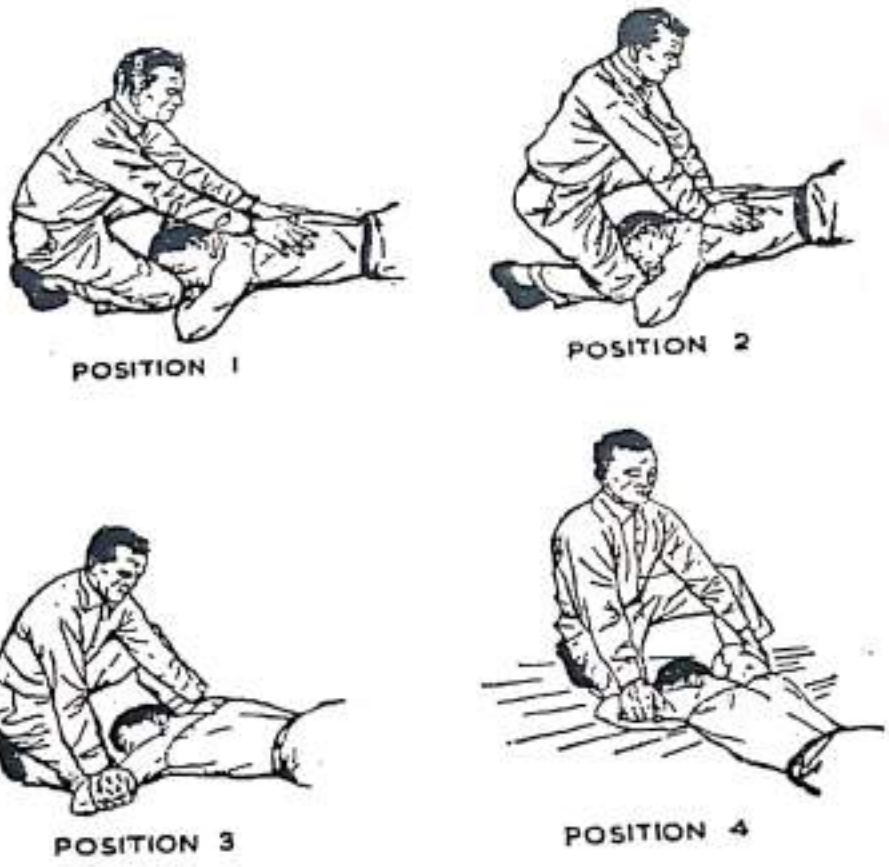

Fig. 3 Nielson's Arm-Lift Back-Pressure Method

b. *Position 2*—Then gently rock forward keeping arms straight until they are nearly vertical thus steadily pressing the victim's back. This completes expiration.
c. *Position 3*—Synchronizing the above movement, rock backwards, releasing pressure and slide your hands downdard along the victim's arms and grasp his upper arm just above the elbows. Continue to rock backwards. 13
d. *Position 4*—As you rock back, gently raise and pull the victim's arms towards you, until you feel tension in his shoulders. This expands his chest and results in respiration. To complete the cycle, lower the victim's arms and move your hands up for initial position.

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

4) Mouth-To-Mouth Method

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

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

Take a deep breath and place your mouth over victim's mouth (*see* Position 2, Fig. 4) making air-tight contact. Pinch the victim's nose, shut with thumb and forefinger or close nostrils