INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

1 Tools and Accessories

Tools, accessories and instruments required for installation, maintenance and repair work. Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation

2.1 Installation of transmission and Distribution Lines:

Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway line crossings, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earth wire and guy wires.

Laying of service lines, earthing, provision of service fuses, installation of energy meters

2.2 Laying of Underground Cables:

Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, including laying of cable from the drum, laying cable in the trench, taking all measurements and making drawings, back filling of trenches with earth or sand, laying protective layer of bricks etc,) laying of cables into pipes and conduits and within buildings.

2.3 Elementary idea regarding, inspection and handling of transformers; pole mounted substations, plinth mounted substations, grid substation, busbars, isolators, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches etc..

2.4 Testing of various electrical equipment such as electrical motor, transformers, cables, and generators, motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out

3. Maintenance

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally, temporary earthing, cancellation of permit and restoration of supply.

Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;

Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes of dim and flickering lights.

3.3 Maintenance of Distribution Transformers

Transformer maintenance and points to be attended to in respect of various items of equipment Checking of insulation resistance, transformer oil level and BDV test of oil, measurement of earth resistance

3.4 Maintenance of Grid Substations

Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors

Over hauling of motors, preventive maintenance, trouble shooting of electric motors

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors, continuity or open circuit test

1 Tool and Accessories

Names of few tools used during installation of electrical equipments are as follows-
Screw drivers, Strippers, Hammers, Pliers, Cutters, Hacksaws, Spanners (flat, ring, socket), Files, Chisels, Taps, dies, Drills (manual, electric), Reamers, Extractor, Knives, Pipe wrenches, Centre punch, Bell and battery set, Compressing tools, Ringing tools, Crimping tools, Labelling machines, Pneumatic scrapper, Jacks, Hoisting mechanism, Files.
These tools cut, strip and twist wires and will secure electrical boxes, light fixtures and switches.
The following are the areas where these tools are randomly being used.
Claw hammer for securing boxes to studs and joist.
Long-nose pliers are bending wires
Lineman's pliers for pulling wires and cutting
Diagonal pliers for cutting in tight spaces
Slotted screwdriver for securing switches and receptacles
Phillips screwdriver for securing switches and receptacles
25-inch measuring tape for setting box heights and so on
Keyhole saw for cutting through walls and ceilings
Hacksaw for cutting flexible, armoured cable
Wire stripper for stripping wire insulation
Cable stripper for stripping wire insulation
Flashlight for working in dark spaces
Ladders for accessing overhead work
Voltage tester for testing of current
Receptacle analyzer for testing of electrical faults
Continuity tester for testing for interruptions in the path of a current
Fish tape for pulling wires through enclosed areas
Conduit bender for bending metal conduit around corners
Level for ensuring that equipment is installed straight and true
Masonry chisels for working on exterior installations
Adjustable wrench for tightening rigid conduit connectors

2 Installation

The process of steel fabrication involves grinding, welding, cutting, bending, drilling, punching, burning or melting and other general crafting methods using various high-quality tools and CNC equipment. The entire steel fabrication process is systematic and requires utmost planning, precision, and knowledge. Steel fabricators are well aware of all the crucial steps and measures that need to be taken care of in the fabrication process. Structural steel is usually fabricated to create structures like beams, trusses, hollow sections, angles and plates.
These steel members must be accurately fabricated before assembling them together. All component parts of these members are fitted-up temporarily with rivets, bolts, or small amounts of welds. Various fastening methods are employed to deliver different types of finishes. Finishing is generally performed by milling, sawing or other suitable methods.
It's important to understand how structural steel structures are designed before assembling them together.
Construction Needs:
First and foremost, it's crucial to know the type of structure you want to construct. Commercial structures have a distinct designing process. Similarly, residential structures are totally dissimilar from industrial structures. Hence, all the structures demand different types of construction processes. Moreover, any and every type of construction process requires unique structures varying in sizes, dimensions, and designs. Each structure has to be specifically designed and fabricated before constructing and assembling them together. For any joint to be site welded, the members will have to be held securely in position such that the setup for welding is accurate and rigid.
Erection Techniques:
Mobile Elevating Work Platforms (MEWPs) and cranes are predominantly used in the erection of steel structures for buildings and bridges. However, there various other techniques that are sometimes used for constructing steel bridges. Cranes are usually divided into two broad categories, mobile and non-mobile cranes. Truck mounted, crawler and all-terrain cranes are included in the first category, while tower cranes are included in the second category.
The MEWPs can be used both on the ground and on the partly erected steel structure, in order to erect lighter steel elements. These MEWPs are used to access the steelwork during erection to bolt up the pieces lifted by the crane. Important measures need to be taken before using the MEWPs such as first checking if the steel structure can support the weight of the MEWP and then determining whether they should be used on the ground or on the erected structures.
Steel Erection:
There are four primary tasks that need to be considered before the steel erection process.
– It is extremely important to establish the foundations and confirm if they are suitable and safe for erection to commence.
– With the help of cranes or sometimes by jacking, lifting and placing components into position is essential. Additionally, to secure the components in place, bolted connections are made but they may not be fully tightened. Similarly, bracings may not be fully secured.
– Aligning the structure is essential, principally by checking that column bases are lined and leveled and columns are plumb. To allow column plumb to be adjusted, packing in beam-to-column connections may need to be changed.
– Last but the least, bolting-up is required, which means completing all the bolted connections to secure and impart rigidity.

Steel fabrication and erecting steel structures are a lengthy process and they require immense skills, knowledge, and practice. Our steel fabricators at Northern Weldarc use the best steel fabrication tools and equipment to ensure that the fabrication and erection processes of steel structures are done with accuracy and perfection.

Steel poles are further classified as follows

Rail Poles: These can be of L shape, rail type and tubular shape. They are better than R.C.C. poles, light in weight and cheaper in cost. The poles are affected by atmospheric moisture, rains, etc. Hence they are always painted or coated with chemicals to avoid rusting. These are normally used for 33kV lines.

Tubular Poles: Tubular poles are either of swaged section (built up sections) or stripped single unit type (jointless one casting). The action of wind pressure is very low because of their circular section as compared to plain section R.C.C. poles and can be erected easily by digging pits of diameter or section slightly greater than the pole's diameter. These are normally used in hilly areas.

Cement poles are further classified as follows *R.C.C. poles*: These poles are made by reinforcing (i.e. embedding) steel rods into concrete slabs of pole shaped cylinders. These poles are of permanent nature, have a long life, remain unaffected by rain, sunlight, etc. and are heavy in weight due to the presence of concrete and steel.

P.S.C. poles: Pre-stressed cement concrete poles are essentially made of concrete. A frame of high tensile steel wire is inserted into a mould and stretched to a certain level. Galvanized wire is used as earth wire inside the mould. A right proportion of concrete mix is poured in the mould and a vibrator is used to compress the concrete to produce high strength PSC poles

Wooden poles wooden poles are light in weight and cheap in comparison to all other types of poles, made up of wooden beams. These are easily affected and spoiled by atmosphere and rain water.

The term "**jumper wire**" simply refers to a conducting **wire** that establishes an **electrical** connection between two points in a circuit. You can use **jumper wires** to modify a circuit or to diagnose problems in a circuit. The following steps outline how you can safely use **jumper wires** in different **electrical** applications.

Bypassing resistances, in effect, creates a short circuit. This may, in turn, cause damage and fire. **Jumper wires should** only be **used to bypass** lengths of **wire** or to simulate switches. **Jumper wires** are simple, yet extremely valuable, pieces of test equipment.

To make your own jumper wire, follow these steps:

Cut the wire to the length you need, using a wire-cutting tool.

Strip off about 1/4- to 1/3-inch of insulation from each end.

Bend the exposed ends of wire at a right (90-degree) angle.

Minimum clearances between Electrical Lines crossing each other

Voltage	**66 KV**	**132 KV**	**220 KV**	**400 KV**
66 KV	2.4 Meter	3 Meter	4.5 Meter	5.4 Meter
132 KV	3 Meter	3 Meter	4.5 Meter	5.4 Meter
220 KV	4.5 Meter	4.5 Meter	4.5 Meter	5.4 Meter
400 KV	4.5 Meter	5.4 Meter	5.4 Meter	5.4 Meter

Permissible Min ground Clearance of Electrical Line

KV	**Ground Clearance**	**Over National**

		Highway
66 KV	6.1 Meter	8.0 Meter
132 KV	6.1 Meter	8.6 Meter
220 KV	7.0 Meter	9.8 Meter
400KV	8.8 Meter	10.8 Meter

2.3 Earthing of transmission line

We should probably earth each tower of an electrical transmission line. We must measure footing resistance of each tower. We should take the footing resistance of tower in dry season before stringing the earth wire and/or OPGW (where OPGW is applicable). In any circumstances footing resistance of the tower will not be more than 10 ohms.

We should use either pipe earthing or counterpoise for **earthing of the electrical transmission line tower**. The tower earthing lug should extend beyond the concrete base of the tower leg. We also use lug connector in case of counterpoise earthing. Logically we should pipe earthing to any of the four legs of a tower but practically we should provide earthing to that leg which is specifically marked for providing earthing. Generally the leg members of that leg is marked with capital letter A. It's a normal practice to avoid mistakes by tower erection gang. In case of river crossing and railway crossing towers we provide earthing at diagonally opposite two legs of a tower.

Let us now discuss these **two types of earthing one by one**.

Pipe Earthing of Electrical Transmission Tower

In case of pipe earthing system we use galvanized steel pipe of diameter 25 mm and of length 3 meters. We bury the pipe vertically in the soil in such a manner that the top of the pipe shall be 1 meter below the ground level. Where the tower stands on rock we have to bury the earthing pipe in damp soil available nearer to the tower.

Then we connect the tower leg with the pipe with the help of galvanized steel tape of suitable cross section. In that case we have to bury the steel tape in a groove cut on the rock and adequately protect the steel tape from damage.

2.4 Guarding:

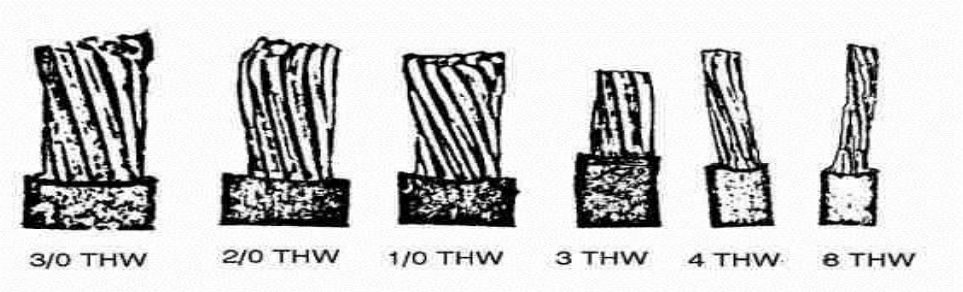
A guarding is provided for the safety of life, installation, and communication circuits.

The guarding for 11 KV lines is provided at road crossings, canal crossings, railway crossing, crossing over lt lines or communication lines.

Regarding guarding of line crossings or approaching each other IER 87 provides all-important guidelines, IER(Indian Electricity Rule) 88 provides that every guard wire shall be connected with the earth at each point at which electrical continuity is broken.

Every guard wire should have sufficient current-carrying the capacity to ensure the circuit rendering dead, without risk of fusing of the guard wire or wires till the contact of any line wire has been removed.

Introduction to Choosing Electrical Wire Size



It's not as difficult as one may think to get a reasonable handle on the electrical service capacity at a building without sophisticated analysis. But there are some pitfalls that can make for big mistakes in your guess at the service ampacity for a property, and the process itself is dangerous. In answering the question "How do I determine the service amperage?" start by taking a look at the service entry cables outside and at their entry into the electrical panel.

A quick look can tell us if the property is served by 240V or only a 120V service, even before measuring the gauge or wire thicknesses that we discuss below.

In the photo above on this page we can see a three wire mast-head, suggesting that the building has a 240V service. But we did not like the position of that weather-head, and we considered that water may be entering the SEC.

The amperage provided by the electrical service entrance cable is a function of its materials and diameter. Often the actual cable type and size is printed right on the cable insulation. Otherwise some rough measurements of cable diameter are in order.

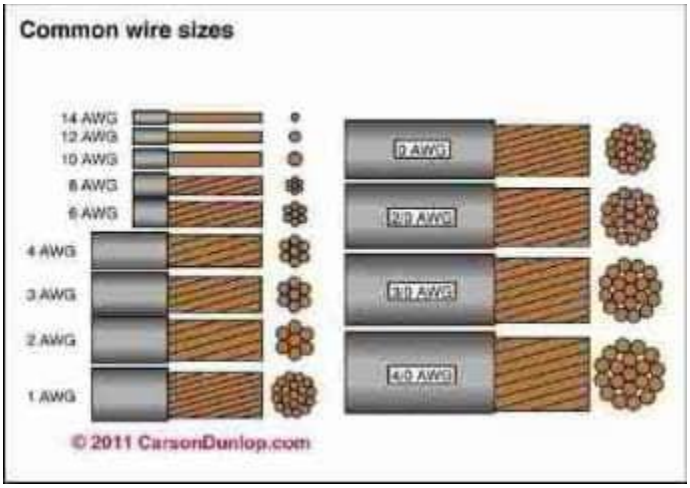
If, inside the panel, the inspector could see the ends of the entrance cable [Figure at left], measure metal wire diameter, and if the inspector knew the manufacturer of the cable and its specifications, a certain identification of the cable's ampacity could be made.

However a safer, faster and common practice is to examine the exterior of the cable at a point outside of the electric panel.

Many SECs include printing right on the external jacket of the cable that will tell you the number of conductors, the metal (AL or CU), and the wire size.

Watch out: Make sure you look at both outside (mast head down to meter) and inside (from meter into service panel).

They may be different! Inside the panel, stripped of ground and insulation, you may see only wires as in Figure 3. Don't confuse guides for external measurements of the whole cable with in-panel measurements of the wires themselves.



Static Shielding is also termed as **Guard** Ring. This method uses a large metal ring surrounding the bottom insulator unit and connected to the **line**. Equalizing the voltage drop across each insulator unit and protects the insulator against flash over.

Laying Of Underground Cables

Underground cables are, of course, meant to be installed or laid under the ground. The reliability of underground cable network highly depends upon proper laying of cables, quality of cable joints and branch connections etc. There are three main **methods of laying underground cables**, which are - (i) direct laying, (ii) draw-in system and (iii) solid system. These three methods are explained below with their advantages and drawbacks

Direct Laying Of Underground Cables

This method is the most popular as it is simple and cheap. The cables to be laid using this method must have the serving of bituminised paper and hessian tape so as to provide protection against corrosion and electrolysis. The **direct laying procedure** is as follows.

Laying Procedure

A trench of about 1.5 meters deep and 45 cm wide is dug.

Then the trench is covered with a 10 cm thick layer of fine sand.

The cable is laid over the sand bed. The sand bed protects the cable from the moisture from the ground.

Then the laid cable is again covered with a layer of sand of about 10 cm thick.

When multiple cables are to be laid in the same trench, a horizontal or verticle spacing of about 30 cm is provided to reduce the effect of mutual heating. Spacing between the cables also ensures a fault occurring on one cable does not damage the adjacent cable.

The trench is then covered with bricks and soil to protect the cable from mechanical injury.

Advantages

Simpler and cheaper than the other two methods

Heat generated in cables is easily dissipated in the ground.

Disadvantages

To install new cables for fulfilling an increased load demand, completely new excavation has to be done which costs as much as the new installation.

Alterations in the cable network are not easy.

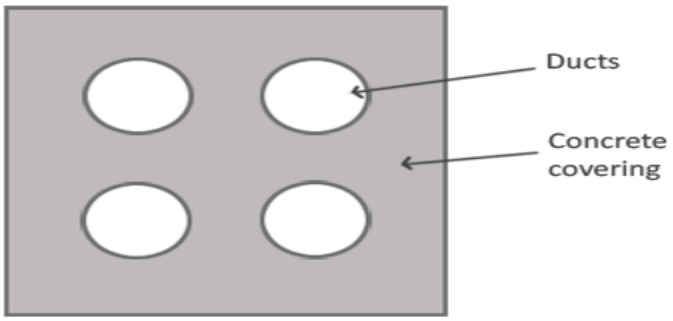
Maintenance cost is higher.

Identifying the location of a fault is difficult.

This method cannot be used in congested areas such as metro cities where excavation is too expensive.

Draw-In System

In this method, cast iron or concrete pipes or ducts are laid underground with manholes at suitable positions along the cable route. The cables are then pulled into the pipes from the manholes. Usually, an additional pipe/duct is also provided along with the three cable ducts for carrying relay protection connections and pilot wires. Distance between the manholes should be such that pulling in the cables is easier. At corners or while changing the direction of route, radius of the corners must be longer. The cables that are to be laid in this way need not be armoured but must be provided with the serving of hessian and jute in order to protect them when being pulled.



Advantages

Repairs, additions or alterations to the cable network can be easily made from manholes without re-excavation.

In this method, as the cables need not be armoured, the cable jointing procedure becomes simpler.

Maintenance cost is quite lower.

Fewer chances of fault occurrence due to the strong mechanical protection provided by the system.

Disadvantages

The initial cost is very high.

Due to unfavourable conditions for dissipation of heat, current carrying capacity of the cables is reduced.

Solid System

In this method, the cable is laid into troughing of cast iron, stoneware, asphalt or treated wood. When the cable is laid into the position, the troughing is filled with a bituminous of asphaltic compound and then covered over. Cables to be laid in this manner could be just lead covered as the troughing provides a good mechanical protection.

This method is very rarely used nowadays as it is more expensive and requires skilled labour and favourable weather conditions.

2.5 Transformers

Standard transformer tests performed for each unit include the following-

Ratio, for voltage relationship

Polarity for single- and 3- phase units, phase relationship for three phase units.

Excitation current, which relates to efficiency and verifies that core designis correct.

No-load core loss, which also relates to efficiency and correct core design.

Load loss which is directly relates to transformer efficiency.

Regulation which determines voltage drop when load is applied.

Applid and induced potentials, which verify dielectric strength.

Pole Mounted Substation

Such substations are used for supporting distribution transformers having the capacity up to 250 KVA. Such types of transformers are the cheapest, simplest, and smallest of distributions. All the equipment is the outdoor type and mounted on the supporting structures of high tension distribution line. Triple pole mechanically operated switch used for switching on and off the high tension transmission line.

HT fuse is used for protection of the high tension transmission line. For controlling the low tension lines, low tension switches along with fuses is equipped. Lightning arresters are equipped over the high tension line for the protection of the transformers from the surges. Pole-Mounted substations are earthed at two or more places.

Pole-Mounted Outdoor Substation

The transformers having a capacity up to 125 KVA are mounted on the double pole structure and for the transformer having a capacity between 125 to 250 KVA 4-pole structure with the suitable platform is used. Such types of the substation are placed in very thickly populated location. Their maintenance cost is low, and by using a large number of the substation in a town, it is desirable to lay the distributors at a lower cost. But when the number of transformers is increasing, total KVA is increased, no load losses in increases and the cost per KVA increases.

Foundation Mounted/ Plinth Substation

In foundation mounted substation all the equipment area assembled and the substations are embedded by the fence for safety purpose. The equipment required for such type of substations are heavy, and hence the site selected for such type of substation must have a good path for heavy transport. Foundation mounted outdoor substation is shown in the figure below.

Foundation-Mounted Outdoor Substation

Advantages of Outdoor Substation

The outdoor substations have the following main advantages. These are

All the equipment in the outdoor substations is within view, and therefore fault location is easier.

The expansion of the installation is easier in the outdoor substations.
The time requires in the construction of such substations is lesser.
The smaller amount of building material like steel, concrete is required.
The construction work required is comparatively less, and the cost of the switchgear installation is also very low.
Repairing work is easy, and proper space is provided between the apparatus so that the fault occur at one point will not be carried over to another point.
Disadvantages of Outdoor Substation
More space is required for the outdoor substations.
Protection devices are required to be installed for the protection against lightning surges.
The length of the control cables increases which increase the cost of the substation.

Grid Substation-

In electrical grid station is an interconnection point between two transmission ring circuits, often between two geographic regions.

Busbars

Busbars are made up of copper material having rectangular strips of sufficient thickness depending upon how much current is to be carried by it. Bus bars are sources of infinite electrical power from where supply to different feedres is provided.

Isolators

These are essentially off load devices although they are capable of dealing with small charging currents of bus bars and connections.

Isolator design is considered in the following aspects:

Space factor, Insulation security, standardization, easy of maintenance.

Types

Horizontal isolator, vertical isolator types and moving bushing types.

Voltage and current transformer

Voltage transformer is used to measure high value of transmission voltage. It is of step down type high voltage is converted into low value then it is measured using voltmeter.
Current transformer is of step up type it convert large value of current into small this reduced value of current is measured using ammeter.

Lightening Arrestors

These provide a means by which lightning currents may enter or leave the earth without passing through the circuitry to be protected. The lightening arresters or surge diverter is a protective device, which conducts the high voltage surges on the power system to the ground.
Types of lightening arresters
Rod arresters
Horn gap arresters
Multigap arresters
Expulsion type lightening arresters.
Valve type lightening arresters

Control and relay panels, HT/LT circuit breakers, LT switches

Control and relay panels are used in substation for controlling and protecting the transmission and distribution line as well as transformer. This panel consists of the metering instruments to note down the value of voltage, current and frequency etc. Also rely which are connected ensures

that during a fault condition they trip the circuit thereby preventing damage to the electrical equipment.

Installation of Power/Distribution transformer

Site consideration

1 Selection of location
2 Foundation preparations
3 Structural supports

Steps while installing a transformer

1 Preliminary inspection upon receipt of transformer
2 Handle and Lift with care
3 Plans for prevention of contaminants
4 Making connections with work
5 Controlling sound level
6 Making sure the transformer are grounded

Dehydration

Dehydrating breathers are used to prevent the normal moisture in the air from coming in contact with the oil in electrical equipments as the load or temperature changes. This reduces the dehydration of the oil and helps to maintain its insulation.

Dehydrating breathers are filled with silica gel.

Fencing of Yard

It is done to prevent unauthorized persons from gaining access to substation or transformer. This ensures safety of the equipment as well as the person/animal who may accidently come in to contact with high voltage electrical appliances and may receive a fatal shock.

Testing of various electrical equipments

Electrical Motors

Various test conducted on electrical motors

1. Types Tests

-Measurement of stator and rotor resistance
- Open circuit ratio test
- No load current, voltage, power input and speeds.
- Locked rotor test.
- Heat run test for determining temperature rise.
- High voltage test.
- Overload test
- Reduced voltage test at no- load.

2. Routine Tests:

- High voltage tests.
- Insulation and resistance measurement.
- Locked rotor Test.
- Open circuit voltage.

3. Special Tests:

- Shunt voltage measurement.
- Sound level measurement
- Stability of motor to PWM supply.

3 Maintenance

Maintenance

General - This document is intended to establish standard practice as well as to give general advice and guidance in the maintenance of electrical equipment owned and operated by the Bureau of Reclamation. Specific technical details of maintenance are included in other documents which are referenced in this document

Repair and maintenance of lines is very important for uninterrupted supply of electricity. Maintenance is done primarily twice a year, once before monsoon and the next is done after monsoon to see if any breakdown has occurred in the line. Line patrolling, maintaining ground clearance, replacement of insulators, restringing of lines, replacement of burnt jumpers, replacement of damaged conductor, replacement of damaged pole, etc. are some of the cheeks performed during maintenance. Proper maintenance of line improves its life drastically.

SESSION 1: PREPARATION FOR REPAIR AND MAINTENANCE OF POWER DISTRIBUTION LINES

Materials and Accessories used in Power Distribution In this section, we will discuss some materials and accessories used in power distribution. Poles (Supports) The poles or supports are classified according to the material used for it: y Steel y Cement y Wood

Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturer's recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

Maintenance Objectives

- To maximize Production
- Reduce breakdown and emergency shutdowns.
- Optimizing resources utilization.
- Improving equipment efficiency and reducing scrap rate
- optimizing the useful life of equipment.

Types of Maintenance

a) Run to failure Maintenance (RTF)
b) Preventive Maintenance (PM)
c) Corrective Maintenance (CM)
d) Improvement Maintenance (IM)
e) Predictive Maintenance (PDM)

Preventive Maintenance Preventive maintenance (PM) is the practice of maintaining equipment on a regular schedule, based on elapsed time, run-time meter readings, or number of operations. The intent of PM is to "prevent" maintenance problems or failures before they take place by following routine and comprehensive maintenance procedures. The goal is to achieve fewer, shorter, and more predictable outages. **Some advantages of preventive maintenance are:**

- It is predictable, making budgeting, planning, and resource leveling possible.
- When properly practiced, it generally prevents most major problems, thus reducing forced outages,

"reactive maintenance," and maintenance costs in general.
• It gives managers a level of assurance that equipment is being maintained.
• It is easily understood and justified.

Preventive maintenance does have some drawbacks:

• It is time consuming and resource intensive.
• It does not consider actual equipment condition when scheduling or performing the maintenance.
• It can cause problems in equipment in addition to solving them (e.g., damaging seals, stripping threads).

Reliability Centered Maintenance Reliability-

Centered maintenance programs are gaining in popularity and have been piloted in a few Reclamation power facilities with good results. The goal of these programs is to provide the appropriate amount of maintenance at the right time to prevent forced outages while at the same time eliminating unnecessary maintenance. Implemented properly, RCM can eliminate some of the drawbacks of preventive maintenance and may result in a more streamlined, efficient maintenance program. RCM seems very attractive in times of diminishing funding, scarcity of skilled maintenance staff, and the pressure to "stay online" due to electric utility industry deregulation.