

Production and Operation Management

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Production and Operation Management

(MEC250)

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Repair and Maintenance

Maintenance

- Present philosophy of maintenance is based on proverb "*Prevention is better than cure*".
- Maintenance is an effort directed towards the proper up keep and repair of machine, equipment and other plant facilities, which should be responsible for smooth and efficient working of an industry and it helps in increasing productivity.
- Even the best design machine will require repairs; hence the repair must be done at such a time when it may have least disruptions.

Plant Maintenance

- Plant maintenance may be defined as scientific and systematic up keep of machines, equipment's and other plant facilities.

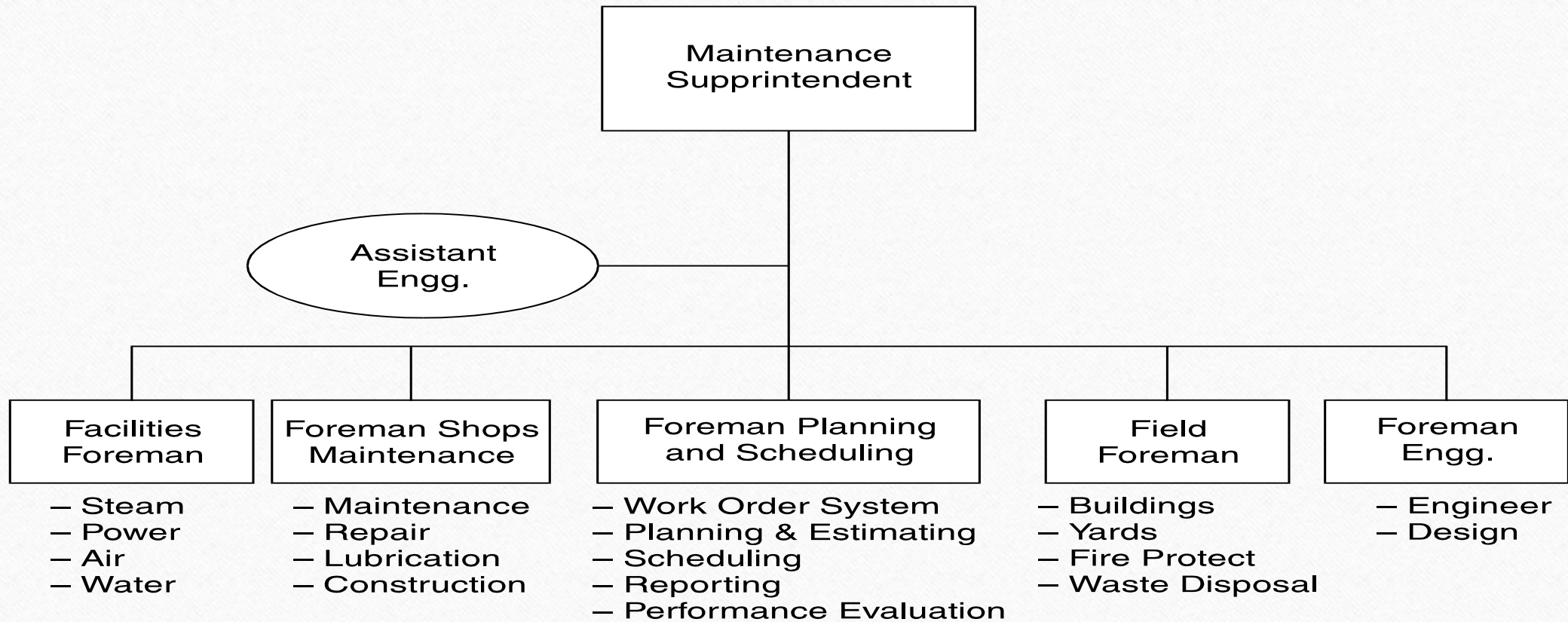
Objectives of Maintenance

- To keep fit the plant item such as machinery, equipment and plant building at lowest possible cost.
- To minimize industrial accident.
- To maximize the useful life of the equipment.
- To minimizing the rate of wear and tear.
- To reduce the frequency of major overhauls of the plant facilities.
- To improve the plant profitability and productivity.

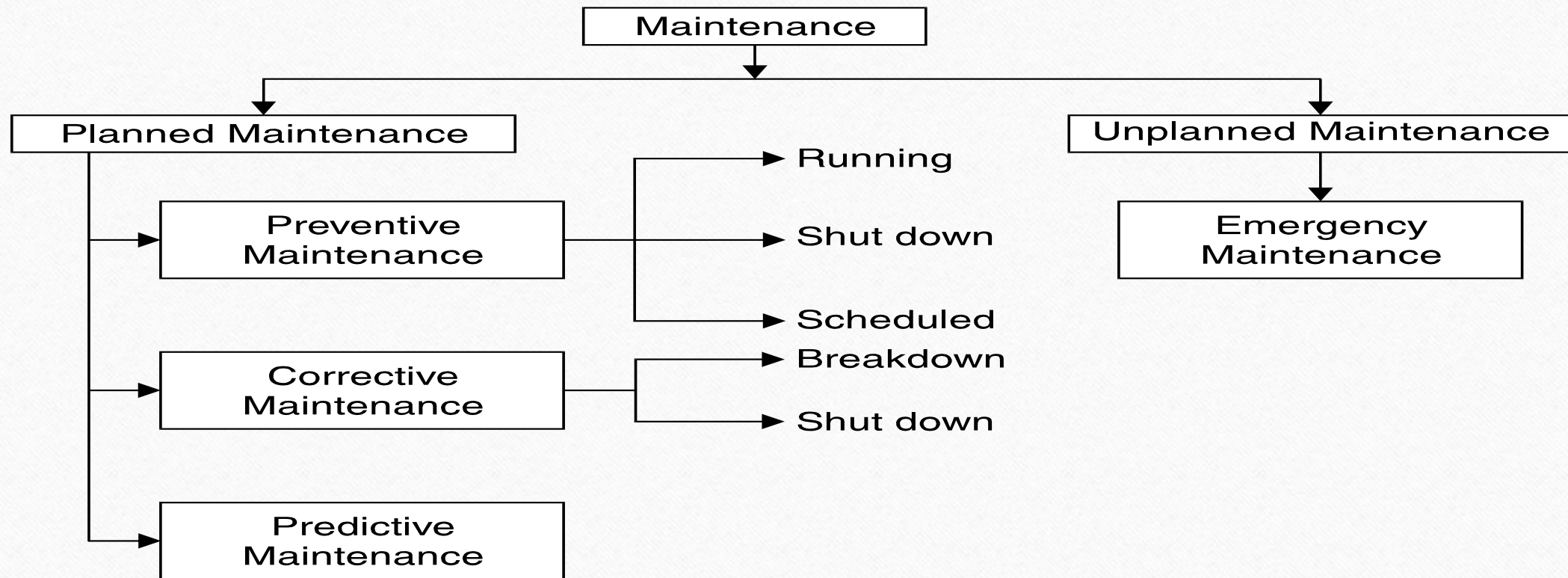
Benefits of Maintenance

- Plants and equipment's are heart of production system. Therefore, proper maintenance of plant and equipment keeping them in good working condition and results good productivity.
- Provides the valuable information regarding the life and reliability of the equipment to the design engineer.
- Failure statics helps to take maintenance policy decisions as to whether to go for repair or preventive or replacement options.
- Maintenance helps to provide the safe working conditions thus increases the job satisfaction among the workers and provides better industrial relations.

Organization of Maintenance Department

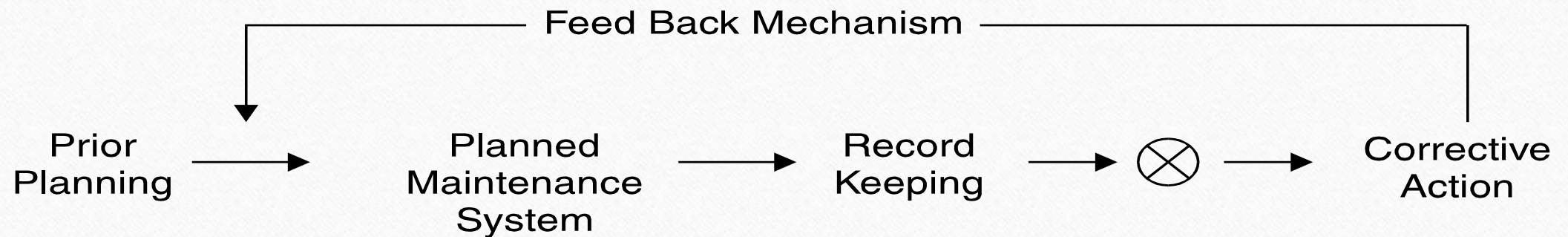


TYPES OF MAINTENANCE



Planned Maintenance

- In planned maintenance, the maintenance action is carried out with some fore thoughts, prior planning, record keeping and control actions is called planned maintenance.



- ✓ Preventive Maintenance
- ✓ Corrective Maintenance
- ✓ Predictive Maintenance

Preventive Maintenance

- The underlying principle of preventive maintenance is that “*Prevention is better than cure*” or “*A stitch in time saves the nine.*” In this maintenance, objective is to reduce wear and tear and to ensure smooth running of machine.
- Four aspects are of immense importance namely
Inspection (I), Cleanliness (C), Lubrication (L) and Routine repairs (R).
- In other words, the preventive maintenance is anticipation of the failure and adoption of necessary preventive action before the occurrence of failure.

Types

Preventive maintenance is of three types:

- (i) Running maintenance
- (ii) Scheduled maintenance
- (iii) Shut down maintenance

Running Preventive Maintenance

- The running maintenance action can be performed while the item or a plant facility in service.
- For example, lubrication of moving parts, adjustments and setting of nuts and screws, tightening of loose nuts and bolts etc.

Scheduled Preventive Maintenance

- Scheduled maintenance is a stitch-in-time procedure aimed at avoiding breakdowns.
- It incorporates inspections, lubrication, repair and overhauls of certain equipment's which if neglected can result in break down.
- Schedule maintenance practice is generally followed for overhauling of machines; cleaning of water and other tanks, white washing of buildings etc.

Shut Down Maintenance

- This maintenance is performed during shut down period of plant when the production system is not working.
- In fact, shut down maintenance is of medium frequency maintenance which is performed generally after three or six months.
- This maintenance involves the inspection of plant items which are known or suspected to incurring the above average problem.

Corrective Maintenance

- Corrective maintenance is a planned maintenance action which is performed to restore a failed unit.
- It includes different types of actions like typical adjustment of redesign equipment, problem in gear engagement in vehicle etc.
- It is a sort of rectification work which mainly includes minor or major repairs and partial or complete replacements.
- Corrective maintenance is of two types:
 - (i) Breakdown maintenance
 - (ii) Shut down maintenance

Breakdown Maintenance

- When a system comes to stand still position, the system is taken out from the production for repairs. The system remains idle till the breakdown is attended. As soon as the necessary repairs made, system is put back to use.
- In some practical situations, the cost of preventing a failure may be higher than the cost of actual break down. Therefore preventive maintenance is not economically justified in such cases. In such circumstances we go for breakdown maintenance.

Predictive Maintenance

- In the present time of competition, it has become very important to ensure the availability of a machine for maximum possible time with maximum efficiency. If the machine needs repair, the time of failure and extent of breakdown has to be predicted.
- The predictive maintenance is done by PDCA cycle i.e. “Plan Do Check Act”.

Unplanned Maintenance

- Maintenance action which is carried out without any fore thoughts or prior planning is called unplanned maintenance.
- This type of maintenance action is always a tool of crisis to the management. Emergency maintenance is example of unplanned maintenance.

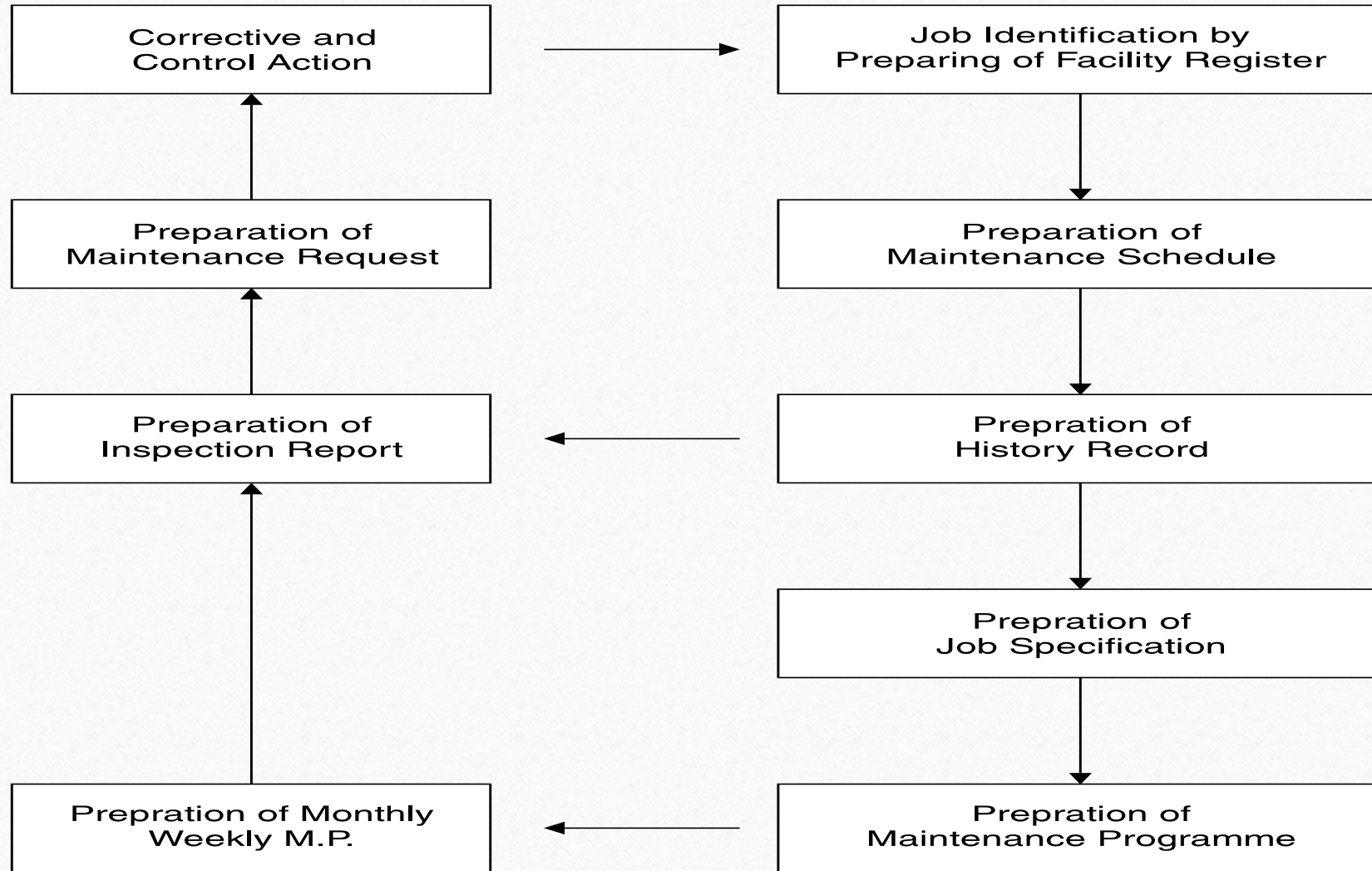
Emergency Maintenance

- Emergency maintenance is an unplanned maintenance action which is always necessary to implement immediately to avoid serious consequences of breakdown.
- The maintenance action is executed with the help of all available maintenance resources in least possible time, without any major time lag.
- In this case the expenditure involved becomes the secondary issue. Gas leakage in chemical plants, fire hazards takes place in any system of plant, serious breakdown of turbine; boiler, pressure vessel etc. are examples of emergency maintenance.

Procedure of Preventive Maintenance

- There is no readymade program available for preventive maintenance in the market. It depends upon the size, age, location, machinery, resources and construction of industries. The planned maintenance procedure (PMP) provides the brief information about the various aspects like:

- 1) Job Identification
- 2) Maintenance Schedule
- 3) History Card
- 4) Job Specification
- 5) Maintenance Programme (weekly or monthly)
- 6) Inspection reports
- 7) Maintenance request (from user) or suggestions from user or feed back.



- **Job Identification by Preparing of Facility Register:** The very first step of (PMP) Planned Maintenance Procedure is to prepare the facility register which defines that what has to be maintained. It is complete document which provides a detailed list of all the plant items and facilities, which are to be maintained in the near future or in coming times.
- **Preparation of Maintenance Schedule:** Maintenance schedule is simply a comprehensive list of the entire incident and their time of incidence.

It gives the useful information regarding the method, time and place of maintenance work, besides it also provides secondary information about maintenance man power requirement etc. It gives the complete time phasing of maintenance loading i.e. various essential details like what, when, how, where etc. of maintenance job.

- **Preparation of History Card:** The third step under Plant Maintenance Procedure (PMP) is to prepare the history card or record for each and every plant facility.

It not only gives the useful information about the result of maintenance events but also furnishes the essential details regarding the uses of machines, frequency of failures and failure modes etc.

During this planning stage, the documents has been prepared about the maintenance actions taken in the part and also try to review and update the available information about the machines their failures and maintenance mechanisms.

- **Preparation of Job Specification:** The fourth step under Plant Maintenance Procedure (PMP) is to prepare the job specification.

Job specification is simply a document which provides the essential information regarding the maintenance work to be done.

In general practice these job details are specifications compiled from maintenance schedules already prepared. Infact, they are a means of communicating the engineer's requirement to guide the workers. They are prepared separately for each job.

- **Preparation of Maintenance Programmes:** The next step under plant maintenance procedure is to prepare maintenance program. It is a sequential list which allocates specific maintenance work to a specific period.

- **Preparation of Weekly/Monthly Maintenance Programmes:**

It is not easy to put every facility of a system under daily maintenance as it would be quite expensive and time consuming. So, a detailed schedule of every item is made along with time period after which it requires servicing or maintenance. It is known as maintenance frequency.

The maintenance program included the following topics:

- Reconditioning or replacing the lubricating oil.
- Repairing or replacing the worn out parts and tools etc.
- Checking for all the electrical connections of the system.
- Check for the control system.
- Checking for the performance of each part, whether it is performing up to level or not.
- Cleaning of Interior parts like spark plugs, filters, radiators, crankcases, cylinders etc.
- It may not include the complete overhauls. But this comes under the long run maintenance program.

- **Preparing of Inspection Report:**

It is just followed after the maintenance program is over. The inspection report is simply a document which furnishes the useful information about the maintenance inspections (generally preventive in nature) which were performed in the past.

Sometimes, job report may also be attached with the inspection report which gives all the details about the maintenance jobs which has been performed on various machines earlier.

On completion of the inspection work, the inspection report is returned to the maintenance foreman who checks and signs the inspection report before passing it back to the Maintenance Engineering Department (MED).

- **Preparation of Maintenance Request:** The next step under plant maintenance procedure is to preparation of maintenance request.

It is simply a document or various maintenance suggestions and recommendations given by Inspection Report. Suggestions are the useful feed back information that comes from users end workers.

- **Feed Back Mechanism:** The last step under Plant Maintenance Procedure (PMP) is the application of corrective and control actions as and when required on the basis of feed back information available to the system.

These corrective actions should be applied to respective plant facilities at the initial stage of maintenance planning or design.

We may conclude that planned maintenance procedure is the methodology of maintenance planning which explain all the important steps right from preparation of facility register to corrective actions (CCA).

Advantages of Preventive Maintenance

Some advantages of preventive maintenance may be summarized as:

- Less production downtime
- Less overtime payment of necessary maintenance
- Less repetitive repairs
- Lower repair cost
- Better quality control and less rejects
- Less standby equipment needed
- Greater safety
- Minimum inventory
- Increased equipment life
- Increase the plant productivity and profitability.

Disadvantages of Preventive Maintenance

Some disadvantages of preventive maintenance may be summarized as:

- Generally, preventive maintenance has no major limitations. But the cost factor is only limitation concerning preventive maintenance.(High cost in small scale industries without any appreciable return)
- Sometimes preventive maintenance may be very costly affair when the cost of failure is much more than the cost of breakdown. In such cases we generally allow the breakdown of the plant equipment and do not prefer preventive maintenance.
- Preventive maintenance system cannot be applied or well suited to small scale manufacturing unit batch and job order production system.

ESSENTIAL REQUIREMENTS OF A GOOD PREVENTIVE MAINTENANCE

The essential requirements of a good preventive maintenance system are as follows:

All the equipment must be uniquely identified by means of a prominent identity number or by a serial number and product type.

Accurate history record of equipment must be provided for every machine in the plant.

It can be easily done with the help of history cards which provides the sufficient information regarding the uses of maintenance events.

Failure information must be available in order to have complete knowledge about the cause of failure and their effects/or consequences.

The term “FRACAS” is used which means “Failure Review and Corrective Actions” and gives a systematic approach to maintain things. Problem ® Cause ® Diagnosis ® Rectification. This system is called failure reporting system.

Collection of secondary data from similar machine or equipment.

Manufacturer procedural recommendation regarding the use of particular machine, spare part, testing equipment's and of courses the uses of safety devices.

Service manuals, maintenance hand books and maintenance sheets must be provided in order to execute properly preventive maintenance action.

Information regarding the use of consumable and replaceable parts.

Information regarding the use of skilled labour (i.e. maintenance manpower)

The proper tools and test instruments mainly for maintenance inspection facility.

Clear instructions must be provided about the type and work quantum of preventive maintenance action i.e. in the form of questionnaire.

Sufficient information should be available about the user's cooperation mainly with the workers.

Management support for establishing a good preventive maintenance system. Top management support is very essential for initiation and implementation of preventive maintenance system.

Question?

Illustrations 1: Preparation of Maintenance Schedule for Centrifugal Pump.

Work (Frequency) Maintenance

(How should be tackled)

- | | | |
|---|--|---|
| 1. Weekly | <ul style="list-style-type: none">- Motor- Coupling- Pump housing- Glands | <ul style="list-style-type: none">- Noise, vibration, temperature- Alignment, security,- leakage, lubrication, Noise,- leakage wear |
| 2. Three Monthly
(Shut down) | <ul style="list-style-type: none">- Bed plate- Motor- Coupling- Pump housing | <ul style="list-style-type: none">- Noise, vibration- Earthling, current leakage- Noise, Packing, security- leakage, wear, noise |
| 3. Yearly
(Annual Shutdown) | <ul style="list-style-type: none">- Coupling- Pump housing- Impeller- Bearings- Glands | <ul style="list-style-type: none">- Alignment, packing, noise- Bearing, condition of house- Condition, Noise, security- Lubrication, security, alignment- wear, leakage |

Illustrations 2: Bansal Electronics, manufacturing T.V. sets and carries out the picture tube testing for 2000 hours. A sample of 100 tubes was put through this quality test during which two tubes failed. If the average usage of T.V. by the customer is 4 hours/day and if 10,000 T.V. sets were sold, then in one year how many tubes were expected to fail and what is the mean time between failures of these tubes?

Solution: The total test time = (100 tubes) × 2000 hours
= 200,000 tube hours

There are two tubes which have failed and hence the total time is to be adjusted for the number of hours lost due to the failures during the testing.

The lost hour is computed as $2 \times 2000 = 2 \times 2000$ hours.

The assumption is made here is that each of the failed tubes have lasted an average of half of the test period.

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Therefore, the test shows there are two failures during (2, 00,000 - 2000)

$$= 1, 98000 \text{ tube hours of testing}$$

During 365 days a year (four hours a day) for 10,000 tubes the number of expected failure are

$$\begin{aligned} &= \times 10,000 \times 365 \times 4 \\ &= 147.47 = 148 \text{ tubes approx.} \end{aligned}$$

Mean time between failure =

$$= 99,000 \text{ tubes hours per failure}$$

$$= \times 365 = 67.68 \text{ tubes year per failure}$$

THANK YOU

