

## **2. MAINTENANCE PLANNING, SCHEDULING AND CONTROL**

### **INTRODUCTION:**

Planning and control consists of:

- Anticipating future work
- Visualisation of the nature and details of the work
- Determination of the best method to perform the work
- Arranging for the required materials
- Securing alterations in production programme or scheduling of maintenance work to conform to production plans
- Allocation of work to individuals
- Instructing the individuals about the schedules and methods
- Follow-up and monitoring the progress or work; and
- Evaluation of the work and performance.

### **ANTICIPATION OF MAINTENANCE WORK:**

The most important function of maintenance is anticipation of future work. This can be done by information provided by the following sources:-

- Instructions and guidance given by manufacturers of the machine.
- Technical knowledge of the maintenance and production personnel.
- Knowledge of the degree of utilisation of the machine.
- Record of the behaviour of the machine and work done on it.
- Complaints and requests from production personnel on the basis of difficulties experienced by them while operating the machines.
- Examination of the state of the various parts of the machine during their life span.

### **VISUALISATION OF THE NATURE AND DETAILS OF WORK:**

Planning for materials, man-powers methods and time required for a job depends on the nature and details of the job. Visualisation of the details of the work to be undertaken in the future can be done on the following basis.

### **TYPES OF MAINTENANCE**

Maintenance activities can be categorized as follows:-

- 1) Preventive Maintenance
- 2) Corrective Maintenance

**Preventive Maintenance System** incorporates the following:-

- 1) PM Main Lists
- 2) Routine Lists
- 3) PM Cards
- 4) Maintenance Instructions

Main List contains the following information :-

1. Unit Number
2. Machine/Part of machine
3. Time Interval
4. Special /Routine
5. Category Of Workmen/Type of work
6. Maintenance Instructions
7. Activity Description
8. Routine List/PM Card No

### **Preparation of PM Main List**

All PM activities to be carried out by a particular trade at a particular frequency for a sub assembly of a unit should be grouped as one activity .The relevant details are to be given in the maintenance instruction. Number of frequencies should be minimum to facilitate planning & control.

### **Routine Lists**

Routine Lists are prepared from Main Lists. Routine Lists will consist PM activities of Routine Nature of **not requiring special planning or stoppage affecting the production schedule** for a group of equipment in a division or section. All such activities will be carried out during a specified week by a designated category of worker. Each Routine List will be numbered and scheduled over the year.

### **PM Cards**

PM Card consists of all PM activities which require **special planning or stoppage involving production loss** and whose frequencies are same.

Activities in each PM Card will be scheduled in a particular week of the year with due consideration to the production plan.

### **Maintenance Instructions**

Maintenance Instructions give the detailed description of the maintenance activity. This is to enable the worker carry out the activity as per the specified method.

## **CORRECTIVE MAINTENANCE**

Corrective Maintenance arises out of the following:-

1. Breakdowns
2. Malfunctioning reported by Production
3. Abnormalities observed by Inspection

The operating personnel should be asked to provide information about the nature of trouble experienced by them.

Reports of inspectors should indicate the part needing attention and the type of attention required.

Drawing of the machine should be used to determine the work required to be done to reach, remove and replace the defective parts.

### **DETERMINATION OF THE METHOD TO PERFORM THE WORK:**

The discipline of Method Study aids the maintenance engineers in deciding the most effective methods of performing work. The techniques of PERT helps in sequencing and scheduling of different activities carried on a plant or machines.

### **SCHEDULING OF WORK TO SPECIFIC TIME PERIODS:**

Scheduling of maintenance requires concurrence of production personnel to release the machine during the specified time. Maintenance personnel can not expect to carry out their own plan and then to assume that it will be acceptable to production people. Scheduling of maintenance work can be done on the basis of the importance of this work in relation to production requirements and the duration of machine downtime and its consequent effects on production and sales programme.

Scheduling of maintenance work require dovetailing of maintenance and production schedules. For this purpose, it is necessary to involve production personnel in decisions regarding the job to be carried out, priority of each job and the time when it should be undertaken. Maintenance department should for this reason prepare a tentative schedule of maintenance work for at least two weeks and circulate it to production dept. and then get their agreement.

The maintenance department should for its own work, think in terms of a long term schedule and a short term schedule. Each of these schedules would include the following activities on the basis of the information provided by the source indicated.

<b>TYPE OF SCHEDULE</b>	<b>ACTIVITIES</b>	<b>SOURCE OF INFORMATION</b>	
Long term:	1. Lubrication	1. Manufacturers	
	2. Inspection	recommendation	
	3. Overhauling	2. Technical	Experience
	4. Cleaning of machine	3. Analysis of history	
	5. Replacement	4. Analysis of life	

of some items span

Short term:	1. Repairs	1. Inspection reports
	2. Replacement	2. Complaints and requests of operating personnel

Here, the term 'long term' means a plan for a period of a year or more. Short term plan can be for a period between 15 days to two months. It can sometimes even be a plan for the next week.

## **WORK ORDERS**

The individuals who are required to execute the work need to be instructed about the work to be done by them, the method they should adopt, the time when they should commence work and the time at which they are expected to complete the job. One good way of passing on necessary information is the use of work orders.

Work Orders are absolutely necessary to control the execution of the plan and for later evaluation for the following reasons.

The work order contains a number which assists in identifying the job on schedule boards or for future references; the work order number should preferably also indicate cost centre where the work is carried out. The work order contains information that is necessary for correct allocation of maintenance costs:

Work Order provides information about scheduling time (and the consequent labour costs) and material as well as actual time taken and material actually consumed as a necessary means of assessing performance.

For reasons stated above, every maintenance work should be undertaken against a work order. Routine work which is carried out every day (e.g. cleaning and oiling) can be done against a standing work order. For other jobs a Work Order should be issued every time such job arises. This is the only way to correctly account for and apportion every minute of time spent by maintenance.

## **PLANNING & SCHEDULING OF MAINTENANCE WORK:**

Basic requirements of organising planning and scheduling of maintenance work are:

To the extent possible a separate and a capable person should handle the planning and scheduling work and he would report to the In-charge of the Maintenance Department. He should be responsible for co-ordinating the

- a) Schedule of maintenance personnel
- b) Spare parts stock control, and
- c) Shutdown or breakdown time control

This person will assist Maintenance In-charge in evolving the maintenance methods, develop and improve them, development of new maintenance tools and materials. He will also assist the

In-charge in establishing 'time' for various work which will be the basis for working out the maintenance schedules.

Maintenance In-charge will have the full responsibility for the work of the maintenance department. He should report only to the top manager of the establishment. The planning and scheduling person has the basic responsibility for determining the job priorities, ensuring that required tools and materials are available and written schedules of jobs are prepared and distributed.

The person holding the charge of maintenance planning should be the same level as that of the in-charge of production departments to be effective. His understanding of various maintenance methods, crafts and shop services is important.

#### **SOURCES OF SCHEDULING DATA:**

1. Repair note is the primary source of information for scheduling purpose.
2. Maintenance Methods and time estimates, evolved earlier for various maintenance work, will give information regarding the various trades and the work-load involved.
3. Load schedule and the progress report of the various maintenance crews will give information with respect to their availability.
4. Special Material for maintenance and Spare Parts records in the stores will be the source of information as to their availability.
5. Plant Production schedule is the source of information as to the time when the equipment could be available for maintenance work and necessary servicing.

#### **TYPES OF SCHEDULES:**

The size of the maintenance organization and the complexity of the plant's maintenance functions will determine the types and frequency of schedules. In general, however, there are three principal classes of schedules which should be used regardless of the plant size. They are:

1. The preventive maintenance master overhaul and inspection schedule.
2. The daily man assignment schedule.
3. The area maintenance schedule.

#### **PREVENTIVE MAINTENANCE MASTER SCHEDULE:**

In most plants, there are many items of equipment which must be taken out of service at regular intervals for inspection and overhaul. The frequency of such occurrences varies with the equipment. Experience, guided by statistics, permits establishing the frequency, so that the lowest overall maintenance cost results. After the frequencies have been

determined, long-range master schedules are prepared. These must be coordinated with plant production schedules (optimum point is when the maintenance cost equals cost of lost production shutdown period).

The maintenance overseer prepares detailed methods write-up which include step-by-step descriptions of each inspection and/or overhaul. The work to be done by each trade and shops is set forth in detail so that their activities can be measured and scheduled accurately.

The master schedules are integrated into the daily and weekly schedules so that the regular preventive-maintenance work becomes a part of the overall plan-maintenance programme. This ensures continuity and regularity of the preventive phases of maintenance work.

### **The weekly work schedule:**

The weekly schedule provides information to each trade and the machine shop concerning the work to be done on each job for each day in the following week. It should be prepared and released on 4th day or at least latest by 5th day noon, to cover work to be done for the next week.

The weekly schedule must be prepared in co-operation with the shop supervisors and integrated with the plant production schedule. This schedule contains the number of men hours required daily for each trade for each job. Information derived from statistical analysis of plant maintenance department records is used to estimate the amount of time to be allowed for each trade for handling emergency work that are not possible to be scheduled in advance.

The man-hour data provides the basis for scheduling the maintenance force. Also by reviewing the unscheduled back log at the time the schedule is made, the need for hiring additional craftsmen, shop personnel, or labourers is evaluated. When the back log shows tendency to increase, steps should be taken to enlarge the work force. Another advantage to be derived from the weekly schedule is related to the statistical analysis of emergency work. If such an analysis shows that 10 per cent or more of any trade's time is required to handle unscheduled work, further analysis should be made to determine caused of this emergency work. In most cases, a more effective preventive maintenance program based on these facts will permit the amount of unscheduled work to be reduced substantially.

### **The Daily Man Assignment Schedule:**

Towards the close of each day, each foreman prepares a daily man-assignment schedule for each person under his supervision. These schedules are based on the weekly schedule, but are modified as necessary to compensate for change forced by fluctuating amounts of unscheduled work and unexpected delays in the scheduled work.

The scheduling group should be advised by the foreman of all variations from the weekly schedule, as well as of all completed work. Whether or not the daily schedule is written will depend on the size and complexity of the organization. Generally, there is no need for a formal schedule. The scheduling usually consists of the foremen's handling the trades-men, one or more work orders, or job plan with the sequence in which they are to be done. Upon completion of the work, the foremen notifies the scheduling group. Each day's progress is reflected in the next day's schedule. By 4th day noon, sufficient data are available to prepare the weekly schedule for

the next week on a realistic basis.

**Area Maintenance Schedules:**

Many of the functions performed by the area maintenance personnel can be scheduled on detailed weekly schedules. Such items as Lubrication, instrument inspection, machine inspection and adjustment, and the like are of this nature. Usually these activities can be scheduled with considerable accuracy. Periodic audits of these schedules are made by the scheduling group to determine the validity of their time estimates.

**Size of Maintenance Force:**

The number of people in a department and the types of maintenance trades represented will determine the number of different types of functional organizations required. Maintenance supervision is of greatest value to the company when it makes use of certain definite skills and abilities. The skills are not always used in a uniform manner but are needed in different proportions at different levels of management. Table-1 shows clearly that the higher the level of maintenance supervision, greater the emphasis on broad management functions, such as planning, organizing, co-ordinating and controlling.

TABLE - I

Skills Required (in %)				
Level of Maintenance Management	Tech- nical	Manage- rial	Adminis- trative, financial	Total
Foreman	50	25	25	100
Asst. Mgr./ Engr.	35	35	30	100
Sr. Mgr./ Engr.	15	50	35	100

It is better to expand the span of control of each supervisor to the maximum he can handle; this will cut down the number of levels and the number of supervisors. In actual practice, this provides for closer relationships between supervisors and their workers. In the area of communications, it results in closer co-ordination and more control since it will decrease the length of communications.

The size of the maintenance force which will be required to support any individual plant can seldom be stated in general quantitative terms. There should be sufficient manpower to meet the demand in peak leads, but not to create a surplus of labour or the problem of idle labour will occur. The size of the staff doesn't effect the adoption of a maintenance control system (work measurement program) since the system itself can be adopted to any size of maintenance department and will work effectively.

Management can project its planning to forecast peak load periods and staff for an overall, annual average which will plan for production departments to help out at peak load times. When maintenance is performed on a break down basis, it must, necessarily, use excessively large crews since break downs must be repaired at once.

Ratios such as,

1. Maintenance manpower to total plant manpower,
2. Maintenance expense to value of equipment and
3. Relation of design to maintenance work load.

are useful guides should be used accordingly. The strict application of ratios should be performed with great caution for maintenance varies greatly from Industry to Industry and from plant to plant, depending on equipment used, type of manufacturing process, variation in accounting, design, and purchasing procedures, and size of plant. Once a ratio is developed from historical data for a particular plant, it can be extremely helpful in maintaining a proper size relationship between maintenance and plant manpower.

## **MAINTENANCE CONTROL**

**Maintenance Control** can be of three types as follows:-

1. Work Control
2. Equipment Control
3. Cost Control

**Work Control** is done through periodic reporting of the progress of various maintenance activities.

**Equipment Control** is the process of carrying out **Failure Analysis and Downtime Analysis** and of taking corrective measures such as **Design-out Maintenance and Design-for Maintenance**.

**Cost control** is exercised by the identification of **high-cost areas** through periodic reporting of PM Costs & CM Costs department/section/equipment-wise and initiating necessary action to reduce the same.

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