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## UNIT 4 PLANNED MAINTENANCE MANAGEMENT SYSTEM AND CONTROLS

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### Objectives

After studying this unit you will be able to:

- understand the characteristic of planned maintenance,
- understand the working of planned maintenance management system,
- plan the documents for implementing planned maintenance,
- analyze maintenance data for corrective action,
- understand the benefits of planned maintenance.

### Structure

- 4.1 Introduction
- 4.2 Planned Maintenance System
- 4.3 Documents Required in Planned Maintenance
- 4.4 Maintenance Control
- 4.5 Benefits of Planned Maintenance
- 4.6 Summary
- 4.7 Key Words
- 4.8 Self Assessment Questions
- 4.9 Bibliography and Suggested Readings

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### 4.1 INTRODUCTION

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It is well understood that well-planned, properly scheduled and effective communication can accomplish more work, more efficiently, and at a lower cost.

Work properly prepared in this fashion disturbs operations less frequently, and is accomplished with higher quality, greater job satisfaction, and higher organizational morale than jobs performed without proper preparation. Planned maintenance refers to maintenance work that is performed with advance planning, foresight, control, and records. It is characterized by the following :

- The maintenance policy has been stated carefully
- The application of the policy is planned in advance
- The work is controlled to conform to the original plan
- Data are collected, analyzed, and used to provide direction for future maintenance policies.

A planned-maintenance system administers the company's maintenance policy by providing the means of technically and financially directing and controlling the maintenance operations with the objective of higher plant maintenance standards and greater cost effectiveness. The successful planned-maintenance systems are those, which are simple to administer and involve shop-floor personnel in the minimum amount of paper work.

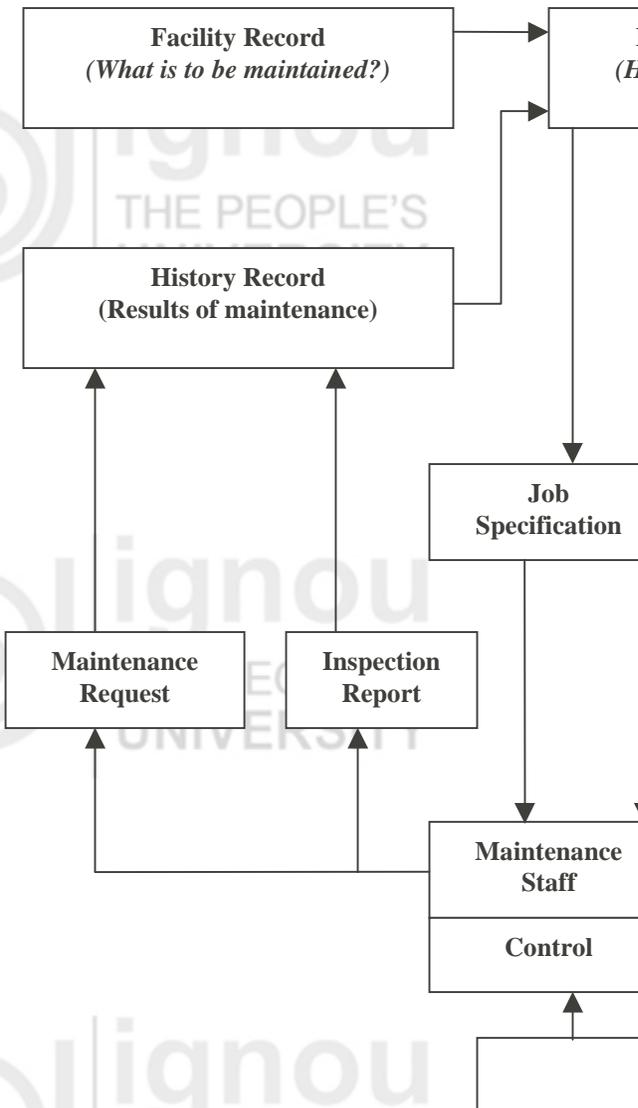
## 4.2 PLANNED MAINTENANCE SYSTEM

Figure 4.1 explains the working of planned maintenance management system. The steps involved in evolving a successful planned maintenance system are as follows :

- i) The first step is to establish what is to be maintained. This involves setting up of a facility record with complete details of all the items in the plant.
- ii) Next step involves preparation of maintenance schedule for every item of plant or equipment, which requires application of planned preventive maintenance. In the first instance this may be done for critical units of the plant. After gaining experience this can be implemented for all the units in the plant.
- iii) Detailed job specifications communicating engineers requirements to the tradesman are prepared. They are prepared separately for each trade and frequency of inspection.
- iv) In order to apply job specification and control their issue, a maintenance program is drawn up. It is convenient to plan preventive maintenance on a weekly basis. This is done in close collaboration with production department. The production planner and planned maintenance controller work very close together. A proper arrangement for plant release for planned maintenance work is an absolute essential requirement.
- v) Each week copies of agreed weekly planning program are distributed by the maintenance planning office to the shop-floor production staff and to the maintenance staff, together with the appropriate job specifications listed on the planning program for distribution to the tradesman selected to carry out preventive inspection. The responsibility to select the tradesman to do this work must be that of maintenance supervisor, who knows which of his men are best suited for the job. Plant must be released according to the program and maintenance persons must be made available to carry out maintenance work.
- vi) A blank inspection report accompanies the job specification. The inspection report is completed by the tradesmen carrying the maintenance job in accordance with the accompanying job specification. Inspection reports are checked and signed by maintenance supervisor before passing it back to the planning office. He can add any pertinent information that might be required for the plant-history record. Any fault which is noticed during planned inspections and not attended because of any reasons is reflected on the inspection report. Planning department schedules these jobs depending on the urgency involved.
- vii) Any emergency work arising at the shop floor is passed on to the maintenance supervision directly by the production supervision in the form of work-order. Work-orders are completed by the tradesmen carrying out the maintenance job. Work-orders are checked and signed by the maintenance supervisor before passing them on to planning office. He can add pertinent information that may be useful for the plant history record:
- viii) Plant history records are compiled from the inspection reports and maintenance requests after completion of the jobs by the tradesmen. Proper analysis of maintenance reports and designing out maintenance as a result of such an analysis helps in raising the maintenance standards and improve the cost effectiveness. As a result of the analysis if emergency maintenance is found to persist, it will indicate one of the following:
  - Insufficient maintenance
  - Incorrect maintenance
  - Inadequate standards of maintenance work.

**Maintenance Overview and Management System**

This will mean increasing the frequency of inspections, modifying the schedule to ensure adequate maintenance of those machines, which are causing emergency maintenance, and closer supervision of maintenance workforce. On the other hand, if few or no faults are reported, this may be because of uneconomic over maintenance. It may require decrease in maintenance actions.



**Figure 4.1 : Planned Maintenance Management System**

**Activity A**

Visit your maintenance department or a nearby plant. Design a planned maintenance management system for it.

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**4.3 DOCUMENTS REQUIRED IN PLANNED MAINTENANCE**

To implement a planned maintenance management system successfully the documents required are maintenance schedules, job specification, work-order, inspection report and history records. Maintenance schedules have already been discussed in the earlier unit. This section contains discussion on all remaining documents.



b) **Work Order**

Work order system helps in planning and controlling of maintenance work. The work order is a form in which written instruction are detailed for work to be carried out and it must be filled up for all jobs. It is also known as work request, work requisition, job card or work ticket. The work order system helps in the following:

- Maintenance work to be performed is requested in writing
- Screening the work requested by operation
- Assigning the best method and the most qualified workers for the job
- Reducing cost through effective utilization of resources
- Improving planning and scheduling of maintenance work
- Maintaining and controlling the maintenance work
- Improving overall maintenance through data collected from the work order to be used for control and continuous improvement programs.

The format of a carefully developed work order form is given in Figure 4.3. This form is split into two by a vertical line running from top to bottom. All the information to the right is used as control input information and concerns the job costing, plant and maintenance coding, priority, cause and action taken, and details of labor hours and class of labor employed. Total repair time directly convertible to labor cost and total downtime, if incurred, are calculated and entered by the planning and control office.

The forms are printed in triplicate. Production and maintenance supervision and other selected members of staff are authorized to generate a work order. The originator fills up information regarding plant description, work required and job priority. First two copies are handed over to appropriate maintenance supervisor for action. After the work has been completed, tradesmen complete the information regarding action taken, cause and time. Work orders are checked and signed by the maintenance supervisor before passing it to the planning office. He can add any pertinent information that the tradesman has not filled up and feels may be necessary for the plant history record. Maintenance planning office completes information regarding total repair time and down time.

The information carried by a work order is as follows:

- Planning Information
  - Inventory number, unit description and site
  - Person requesting job
  - Job description and time standard
  - Job specification and code number
  - Date required and priority
  - Trades required and coordinating supervisor
  - Spares required
  - Special tools and lifting tackle required
  - Safety precaution if any
  - Drawing and manual number
- Control Information
  - Cost information
  - Down time
  - Actual time taken
  - Cause and consequences of failure
  - Action taken

<b>Maintenance Work Order No.</b>				<b>M'CE Code</b>		<b>Plant No.</b>			
<b>Plant Description</b>			<b>Date</b>						
<b>Plant Location</b>			<b>Time</b>						
<b>Work Requested by</b>				<b>When Requested</b>					
<b>Defect/Work required</b>				<b>JOB PRIORITY</b>					
				Emergency	1		Ticket one Box		
				M/c Running	2				
				Not Applicable	3				
<b>CAUSE</b>				<b>Cause</b>					
				Wear & Tear	4		Ticket one Box		
				Accident, Misuse, Neglect	5				
				Component Fallure	6				
				Job Report	7				
				Not Applicable	8				
<b>ACTION TAKEN</b>				<b>Repaired, Manufactured</b>					
				Replaced	10		Ticket one Box		
				Inspected, Adjusted	11				
				Modified	12				
				Relocated Installed New	13				
				Not Applicable	14				
<b>Trade Code</b>		<b>Tradesman's Signature</b>		<b>Date</b>	<b>Time on</b>	<b>Time off</b>	<b>TOTAL HOURS</b>		
							<b>HRS.</b>	<b>MINS.</b>	
<b>Maintenance Supervisor....</b>		<b>Date Completed</b>		<b>Week No.</b>					
						<b>Total repair time</b>		<b>Hrs.</b>	<b>Mins.</b>
		<b>For Office use</b>		<b>Down time</b>					

Figure 4.3 : A Typical Work Order Format

c) Inspection Report

This form is used only for reporting the results of planned productive maintenance inspections, as set out in the job specifications. The inspection report has a close resemblance to the work order. The format for statistical information on costing is identical to the work order and is extracted exactly in the same way. Figure 4.4 gives a typical inspection report format. Job specification number, plant identification details and cost codes are entered by the maintenance planning office. There is no need of a copy, since issue and receipt are recorded on the master copy of the weekly planning program retained in the planning office.





## 4.4 MAINTENANCE CONTROL

Figure 4.6 depicts the maintenance control cycle, which can be defined as follows:

- The objectives could be plant availability, performance and quality
- Sampling output is to collect data from the work order or equipment history records
- Analyzing the sample to determine if the objective has been met. For example, does the level of quality meet customer satisfaction or does it meet specifications? Also, is equipment availability and performance according to desired targets?
- Corrective action could be revising maintenance policies, changing maintenance schedules, upgrading job specifications, training workers and implementing new maintenance programs and strategies if necessary.

**Figure 4.6 : Maintenance Control Cycle**

This requires the establishment of procedures and forms for administering maintenance work; standards for data collection and analysis; and means for effective reporting of work, equipment condition, and product quality. The latter three items are necessary for work control, cost control and plant condition control. Maintenance control comprises the following three important functions:

- Work order coordination and planning
- Work order processing
- Information feedback and corrective action

Work order coordination and planning is concerned with satisfying maintenance demand while meeting the requirements of production and the capacities of maintenance resources. Work order processing is concerned with work order release scheduling and work dispatch. The feedback and control function essentially deals with information gathering and decision making to achieve set goals and objectives.

Information feedback and corrective action is concerned with the collection of data about the status of the work execution, system availability, work backlog and quality of work performed. Then, this information is analyzed and an appropriate course of action is formulated. This course of actions and decisions is aimed at improving the following:

- Work control
- Cost control
- Quality control
- Plant condition control

a) **Work Control**

This type of control monitors the work status and the accomplished work to investigate if the work has been performed according to standards (quality and time). In this type of control, it is assumed that the maintenance control system includes standards that are assigned in advance of actual maintenance work performed. A set of reports is generated in this category of control. These include a report showing performance according to standard by the trades utilized for the job and their productivity. In this report, it is good practice to indicate what proportion of maintenance work is performed using overtime. Other reports that are useful for work control are backlog percentage of emergency maintenance to planned maintenance and percentage of repair job originated as a result of PM inspection. All these reports reflect some sort of efficiency measures.

The backlog report is essential for work control. It is good practice to maintain a weekly backlog report by trade. The report should also indicate the cause of the backlog. It is essential to have a healthy backlog, which generally ranges from 2 to 4 weeks. Too much or too little backlog necessitates a corrective action. In case a downtrend in the backlog is identified, one of the following corrective actions may be necessary:

- Reduce contract maintenance
- Consider transfer between departments
- Downsize maintenance workforce

If the backlog is increasing and a clear trend is identified, one of the following corrective actions may be necessary:

- Increase contract maintenance
- Consider transfer between departments
- Schedule cost-effective overtime
- Increase maintenance workforce.

The total backlog should be controlled by using statistical process control tools, specifically control charts.

b) **Cost Control**

Maintenance cost consists of the following:

- Direct maintenance cost, which is the cost of labor, spares, material, equipment and tools
- Downtime cost due to breakdown
- Cost of quality due to products being out of specification as a result of machine defects

### Maintenance Overview and Management System

- Redundancy cost due to equipment backups
- Equipment deterioration cost due to lack of proper maintenance
- Cost of over maintaining

Almost all information about cost is available on the work order. A summary of maintenance costs by work order must be issued monthly. This is utilized to control maintenance costs and develop the cost of manufactured products.

The cost reports will indicate the most needed cost reduction programs. Cost reduction should be an ongoing effort in any sound maintenance program. The areas where cost reduction programs can be launched are as follows:

- Considering the use of alternative maintenance materials
- Modifying inspection procedures
- Revising maintenance procedures, particularly making adjustments in the crew size and methods
- Redesigning material handling procedures and the workshop layout.

#### c) **Quality Control**

Maintenance has a direct link to the quality of products. Well-maintained equipment produces less scrap than poorly maintained equipment. It is also well known that the condition of machine affects its process capability.

A monthly report of the percentage of repeat jobs and product rejects may help identify which machines require an investigation to determine the causes of quality problems. Once the machines are investigated, a corrective course of action will be taken to rectify the problem. The action may entail a modification of the current maintenance policy and/or training of a trade force.

#### d) **Plant Condition Control**

Plant condition control requires an effective system for recording failures and repairs for critical and major equipment in the plant. This information is usually obtained from the work order and equipment history record. The records in the equipment history file include the time of failure, the nature of the failure, the repairs undertaken, total downtime, and machines and spares used.

A monthly maintenance report should include downtime of critical and major equipment and its availability. If downtime is excessive or the equipment availability and readiness is low, a corrective action must be taken to minimize the occurrence of failure. The corrective action may require the establishment of a reliability improvement program or a planned maintenance program, or both.

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## 4.5 BENEFITS OF PLANNED MAINTENANCE

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Following benefits are achieved by implementing planned maintenance in any plant:

- Reduction in emergency maintenance:** Implementing planned maintenance leads to decreased number of breakdowns, which results in reduction of emergency maintenance work.
- Reduction in downtime:** Planned maintenance helps in better spare parts management, which ultimately leads to reduction in downtimes
- Increased plant availability for production:** Reduction in downtime and number of emergency break-downs results in increased plant availability.

- iv) **Improved labor utilization on maintenance and production:** In planned maintenance emergency maintenance standby tradesmen are no longer required and can be more productively employed on planned productive maintenance jobs. Production operatives are no longer idle as they were while their machines were under emergency maintenance.
- v) **Extends duration between overhauls:** Raising maintenance standards by regular attention to lubrication, adjustments and replacement of defective components before they cause extensive damage to other parts of a machine extends the life of machines. The need for a complete overhaul becomes significantly less frequent.
- vi) **Reduces spares replacement, assists stores control:** Regular inspections ensures regular replacement of defective components before more extensive damage is caused. Inspections provide early warning of impending component failure, providing time for stores control to obtain parts required if they are not stock items. Panic buying becomes a nightmare of the past.
- vii) **Improves machine efficiency:** In planned maintenance machine performance level is checked and maintained to a predetermined and acceptable standard, machine outputs are raised and percentage 'scrap' is reduced.
- viii) **Provides reliable cost and budgetary control:** Implementing planned maintenance management system in any plant for reasonably long time generates realistic cost data and helps in imposing budgetary controls.
- ix) **Provides information for considering machine replacement:** Apart from obsolescence, it is difficult to justify on financial grounds the replacement of a machine that is working, unless some reliable operating cost information which includes maintenance is available to management. Worn out machinery that is beyond economical repair ties up maintenance labor and spare parts, and maintenance costs continue to remain high. When it can be clearly shown that a machine is beyond economical repair, then it is time to consider its early replacement.

**Activity C**

Visit your maintenance department or a nearby plant. Critically study the work order in practice. What is your suggestion to improve upon the existing one?

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**4.6 SUMMARY**

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Planned maintenance refers to maintenance work that is performed with advance planning, foresight, control and records. A planned maintenance system helps in achieving higher plant maintenance standards and greater cost effectiveness. The successful planned maintenance systems are those, which are simple to administer and involve shop-floor personnel in the minimum amount of paperwork. Maintenance control systems play a key role in an effective maintenance program. It consists of work order coordination, work order processing, feedback information and corrective action. The information is analyzed and appropriate course of actions are formulated aiming at improving work control, cost control, quality control and plant condition control.

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## 4.7 KEY WORDS

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**Maintenance Control:** It deals with information gathering and analyzing it for decision making to achieve set goals and objectives of planned maintenance.

**Planned Maintenance:** It refers to maintenance work that is performed with advance planning, foresight, control and records.

**Work Order:** It is a document used to request, plan, schedule, track and report all maintenance work.

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## 4.8 SELF ASSESSMENT QUESTIONS

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- 1) What are the characteristics of planned maintenance?
- 2) Explain the working of a planned maintenance management system?
- 3) Visit a plant in your area and design a planned maintenance management system for it?
- 4) What are minimum documents required to run a planned maintenance management system?
- 5) What requirements should be met by job specifications?
- 6) What is work order and how does it help in planned maintenance?
- 7) What information could be obtained from a well designed work order?
- 8) Suggest a suitable format for maintaining the equipment history record?
- 9) Describe the maintenance control cycle?
- 10) What are the objectives of maintenance control?
- 11) Visit two plants in your area and collect samples of their work order. For each point out deficiencies and suggest improved work orders?
- 12) What are benefits achieved by implementing planned maintenance?

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## 4.9 BIBLIOGRAPHY AND SUGGESTED READINGS

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- 1) Corder A.S., “*Maintenance Management Techniques*”, Mc Graw Hill, 1976.
- 2) Kelly, A., “*Maintenance Planning and Control*”, Butterworths, 1984.
- 3) Kelly A., “*Maintenance and its Management*”, Conference Communication, 1989.
- 4) Duffuaa S.O., Raouf A. and Campbell J.D., “*Planning and Control of Maintenance Systems*”, John Wiley & Sons, 1999.
- 5) Palmer D., “*Maintenance Planning and Scheduling Handbook*”, Mc Graw-Hill, 1999.
- 6) Nyman D. and Levitt J., “*Maintenance Planning, Scheduling, and Coordination*”, Industrial Press Inc. New York, 2001.