Unit-4

Maintenance Management

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Maintenance Management

INTRODUCTION AND MEANING

- Past and current maintenance practices in both the private and Government sectors would imply that maintenance is the actions associated with equipment repair after it is broken. The dictionary defines maintenance as "the work of keeping something in proper condition, upkeep." This would imply that maintenance should be actions taken to prevent a device or component from failing or to repair normal equipment degradation experienced with the operation of the device to keep it in proper working order. Data obtained in many studies over the past decade indicates that most private and Government facilities do not expend the necessary resources to maintain equipment in proper working order. They wait for equipment failure to occur and then take whatever actions are necessary to repair or replace the equipment. Nothing lasts forever and all equipment has associated with it some predefined life expectancy or operational life.

OBJECTIVES OF MAINTENANCE

Equipment are an important resource which is constantly used for adding value to products. So ,it must be kept at the best operating condition. Otherwise, there will be excessive downtime and also interruption of production if it is used in a mass production line. Poor working of equipment's will lead to quality related problems. Hence, it is an absolute necessity to maintain the equipment's in good operating conditions with economical cost. Hence, we need an integrated approach to minimize the cost of maintenance. In certain cases, the equipment will be obsolete over a period of time. If a firm wants to be in the same business competitively, it has to take decision on whether to replace the equipment or to retain the old equipment by taking the cost of maintenance and operation into account.

TYPES OF MAINTENANCE

The design life of most equipment requires periodic maintenance. Belts need adjustment, alignment needs to be maintained, proper lubrication on rotating equipment is required, and so on. In some cases, certain components need replacement, e.g., a wheel bearing on a motor vehicle, to ensure the main piece of equipment (in this case a car) last for its design life. Different approaches have been developed to know how maintenance can be performed to ensure equipment reaches or exceeds its design life. In addition to waiting for a piece of equipment to fail (reactive maintenance)the other approaches are preventive maintenance, predictive maintenance, or reliability centered maintenance.

1. Breakdown (Reactive) Maintenance:

Breakdown maintenance is basically the 'run it till it breaks' maintenance mode. No actions or efforts are taken to maintain the equipment as the designer originally intended to ensure design life is reached. Studies as recent indicate that, this is still the predominant mode of maintenance.

Advantages to breakdown maintenance can be viewed as a double-edged sword. If we are dealing with new equipment, we can expect minimal incidents of failure. If our maintenance program is purely reactive, we will not expend manpower or

incur capital cost until something breaks. Since we do not see any associated maintenance cost, we could view this period as saving money. In reality, during the time we believe we are saving maintenance and capital cost, we are really spending more money than we would have under a different maintenance approach.

Advantages:-

1. Involves low cost investment for maintenance.

2. Less staff is required.

Disadvantages:-

1. Increased cost due to unplanned downtime of equipment.

2. Increased labour cost, especially if overtime is needed.

3. Cost involved with repair or replacement of equipment.

4. Possible secondary equipment or process damage from equipment failure.

5. Inefficient use of staff resources.

2. Preventive Maintenance:-

Preventive maintenance can be defined as, "Actions performed on a time or machine-run-based schedule that detect, preclude, or mitigate degradation of a component or system with the aim of sustaining or extending its useful life through controlling degradation to an acceptable level. "Preventive maintenance is a means to increase the reliability of their equipment. By simply expending the necessary resources to conduct maintenance activities intended by the equipment designer, equipment life is extended and its reliability is increased. In addition to an increase in reliability, lot of amount will be saved over that of a program just using reactive maintenance. Studies indicate that this savings can amount to as much as 12% to 18% on the average.

Advantages:-

1. Cost effective in many capital intensive processes.

2. Flexibility allows for the adjustment of maintenance periodicity

.3. Increased component life cycle.

4. Energy savings.

5. Reduced equipment or process failure

6. Estimated 12% to 18% cost savings over reactive maintenance program.

Disadvantages:-

1. Catastrophic failures still likely to occur.

2. Labour intensive.

3. Includes performance of unneeded maintenance.

4. Potential for incidental damage to components in conducting unneeded maintenance

3. Predictive Maintenance:-

Predictive maintenance can be defined as "Measurements that detect the onset of a degradation mechanism, thereby allowing causal stressors to be eliminated or controlled prior to any significant deterioration in the component physical state. Results indicate current and future functional capability". Basically, predictive maintenance differs from preventive maintenance by basing maintenance need on the actual condition of the machine rather than on some preset schedule. Preventive maintenance is time-based. Activities such as changing lubricant are based on time, like calendar time or equipment run time. For example, most people change the oil in their vehicles every 3,000to 5,000 miles travelled. This is effectively basing the oil change needs on equipment run time. No concern is given to the actual condition and performance capability of the oil. It is changed because it is time. This methodology would be analogous to preventive maintenance task. If on the other hand, the operator of the car discounted the vehicle run time and had the oil analyzed at some periodicity to determine its actual condition and lubrication properties, he may be able to extend the oil change until the vehicle had travelled 10,000 miles. This is the fundamental difference between predictive maintenance and preventive maintenance, whereby predictive maintenance is used to define needed maintenance task based on quantified material/equipment condition. There are many advantages of predictive maintenance. A well-orchestrated predictive maintenance program will eliminate catastrophic equipment failures. Schedule of maintenance activities can be made to minimize or delete overtime cost.

Advantages:-

1. Increased component operational life/availability.
2. Allows for pre-emptive corrective actions.
3. Decrease in equipment or process downtime.
4. Decrease in costs for parts and labour.
5. Better product quality.
6. Improved worker and environmental safety.
7. Improved worker moral.
8. Energy savings.
9. Estimated 8% to 12% cost savings over preventive maintenance program.

Disadvantages

1. Increased investment in diagnostic equipment.
2. Increased investment in staff training.
3. Savings potential not readily seen by management.

MAINTENANCE PLANNING

Planning of maintenance jobs basically deals with answering two questions, 'what' and 'How' of the job; 'what activities are to be done?' and 'how those jobs and activities are to be done? 'While answering these two questions, other supplementary questions are to be answered, e.g., 'where the jobs is to be done?' and 'why the job is to be done?' etc., but all these will be helping in developing 'what' and 'how' of the job. It is very essential that engineering knowledge must be applied extensively to maintenance jobs for development of appropriate job plans using most suited techniques, tools materials and special facilities etc. As the job planning forms the basic foundations, over which the efficiency and cost of actions depends, persons responsible for job planning should have adequate capabilities, such as, knowledge about jobs and available techniques, facilities and resources, analytical ability, conceptual logical ability and judgmental courage etc.

Steps of Job Planning

The main steps to be followed for proper job planning are:

1**. Knowledge base**: It includes knowledge about equipment, job, available techniques, materials and facilities.

2**. Job investigation at site**: It gives a clear perception of the total jobs.

3. **Identify and document the work**: Knowing the earlier two steps and knowing the needs of preventive, predictive and other maintenance jobs.

4**. Development of repair plan**: Preparation of step by step procedures which would accomplish the work with the most economical use of time, manpower and material.

5**. Preparation tools and facilitie**s list indicating the needs of special tools, tackles and facilities needed.

6. **Estimation of time required** to do the job with work measurement technique and critical path analysis.

MAINTENANCE SCHEDULING

Scheduling is the function of coordinating all of the logistical issue around the issues regarding the execution phase of the work. Scheduled of maintenance jobs basically deals with answering two questions—'Who' and 'When' of job, i.e., "who would do the job" and "when the job would be started and done". Effective scheduling essentially needs realistic thinking, based on substantial data and records. Majority of scheduling work needs to occur in areas such as overhead labour hours safety and toolbox meetings, break times and training times etc. Addition of corrective and approved improvement actions as dictated by the prioritization system and operations plan etc.

Requirements for Schedulers

A scheduler should also have knowledge about job, techniques, facilities, analytical ability and judgmental courage. The scheduler must obtain knowledge/information about following ability and judgmental courage. The scheduler must obtain information about following facts, before starting is job:

1. Manpower availability by trade, location, shift, crew arrangement and permissible overtime limit etc.
2. Man hour back log on current or unfinished jobs.
3. Availability of the equipment or area where the work has to be performed.
4. Availability of proper tools, tackles, spares, consumables, structural and other required materials.
5. Availability of external manpower and their capabilities; these may be from other shops/departments of the plant or from contractors (local, nearby, ancillary etc.).
6. Availability of special equipment's, jigs/fixtures, special lifting and handling facilities and cranes etc. This should also include labour and time saving devices like pneumatic hammers and excavators etc.

MAINTENANCE SCHEDULE TECHNIQUES

Different types of schedules are made suiting the respective job plans and different techniques are used for making and following those schedules. The first step of all scheduling is to break the job into small measurable elements, called activities and to arrange them in logical sequences considering the preceding, concurrent and succeeding activities so that a succeeding activity should follow preceding activities and concurrent activities can start together. Arranging these activities in different fashion makes different types of schedules. They areas follows:

1. **Weekly general schedule** is made to provide weeks worth of work for each employee in an area.
2. **Daily schedule** is developed to provide a day's work for each maintenance employee of the area.

3. **Gantt charts** are used to represent the timings of tasks required to complete a project.
4. **Bar charts** used for technical analysis which represents the relative magnitude of the values.
5. **PERT/CPM** are used to find the time required for completion of the job and helps in the allocation of resources.

Modern Scientific Maintenance Methods

Reliability centered maintenance: Reliability centered maintenance (RCM) is defined as "a process used to determine the maintenance requirements of any physical asset in its operating context". Basically, RCM methodology deals with some key issues not dealt with by other maintenance programs. It recognizes that all equipment in a facility is not of equal importance to either the process or facility safety. It recognizes that equipment design and operation differs and that different equipment will have a higher probability to undergo failures from different degradation mechanisms than others. It also approaches the structuring of a maintenance program recognizing that a facility does not have unlimited financial and personnel resources and that the use of both need to be prioritized and optimized. In a nutshell, RCM is a systematic approach to evaluate a facility's equipment and resources to best mate the two and result in a high degree of facility reliability and cost-effectiveness. RCM is highly reliant on predictive maintenance but also recognizes that maintenance activities on equipment that is inexpensive and unimportant to facility reliability may best be left to a reactive maintenance approach. The following maintenance program breakdowns of continually. top-performing facilities would echo the RCM approach to utilize all available maintenance approaches with the predominant methodology being predictive. l<10% Reactivel25% to 35% Preventivel45% to 55% Predictive. Because RCM is so heavily weighted in utilization of predictive maintenance technologies, its program advantages and disadvantages mirror those of predictive maintenance. In addition to these advantages, RCM will allow a facility to more closely match resources to needs while improving reliability and decreasing cost.

Advantages:-

(a) Can be the most efficient maintenance program.
(b) Lower cost be eliminating unnecessary maintenance or overhauls.
(c) Minimize frequency of overhauls.
(d) Reduced probability of sudden equipment failures.
(e) Able to focus maintenance activities on critical components.
(f) Increased component reliability.
(g) Incorporates root cause analysis.

Disadvantages:-

(a) Can have significant startup cost, training, equipment, etc.
(b) Savings potential not readily seen by management.