maintenance performance factors like availability, reliability, maintainability and safety have not been up to desired level even compared to similar developing countries, not to speak of highly advanced nations. Many organizations concerned about the productivity of such non performing physical assets are now raising the issue of mandated maintenance audits also to be incorporated in the law. Hopefully, in the times to come there would be both a good demand as well as utilization of the 'Maintenance Audit' by Indian organizations. In this lesson, we would cover the various facets of maintenance audit and how the reader would be able to utilize the audit either as an auditor or auditee.

19.2 TYPES OF AUDIT

There are various types of audit that are possible to be carried out in an organization. It would be useful to understand these terminologies so that one is able to understand and appreciate their purpose and requirements for different situations. These are briefly described below:

i) **Statutory Audit** is the audit required by the law enacted by the parliament or legislatures of a country. Sometimes other statutory or semi-statutory organizations like international labour organization, international standards organization etc. also make specific provisions for such statutory audits. On the other hand **Voluntary Audit** is the audit taken by an organization on its own interest.

ii) **Internal Audit** is the audit taken by the internal department or personnel of the company, normally one department auditing the functions of the other department. **External Audit** is the audit conducted by an external agency (neutral third party) either due to the wish of the company management to identify problems for improvement or mandated by an enforcing agency like the Government.

iii) **Preliminary Audit** is normally conducted for a brief period of time to identify major thrust problem areas in a function. The problems so identified may be subjected to detailed examination and problem solving at a later stage. On the other hand a **Detailed Audit** is carried out to study the complete features and requirements of a specific function. Normally a team of members conducts such audit for a considerable period.

iv) **Management Audit** is the audit carried out to check and identify the suitableness of system and procedures of a management function. The audit carried out for ISO-9000 certification is an example of such an audit.

Technical Audit is the process of study of a technical component of a plant, with or without experimentation and instrument monitoring, to identify improvements in both the hardware and software aspects. For example, environment audit of a factory involving measurement of pollution parameters is a predominantly a technical audit.

All these types of audits have some amount of overlapping in their purposes and applicability. For example, a statutory audit can also be a result of the voluntary requirement of the company. Or an external audit team may co-opt an internal member of the company to enhance the understanding of the process being audited. All these types of audits have similar methodologies also. In this lesson, we would be discussing predominantly about the audit of 'Maintenance Management' function and the discussions are applicable to any type of audit mentioned above. The discussion about technical audit in maintenance function is out of scope of this lesson.

19.3 IMPORTANCE OF MAINTENENACE AUDIT

We are aware that maintenance function is a supporting activity to make the planned availability of plant and equipment possible. Since it is not a direct function connected to profits of the organization like production, finance or marketing, it is possible that the necessity of maintenance to be properly managed is overlooked by the top management. At the same time, maintenance management need to be at the optimum level as either over maintenance or under maintenance, both are likely to affect the costs incurred by the organization. We have already seen that though the actual maintenance costs may be only a small proportion like the tip of the iceberg, the consequential cost of improper maintenance could run to million of rupees, like the iceberg hidden below the water level.

We have seen that the maintenance management requires many features to be complied by the different levels of personnel in the organization. In fact, maintenance management requires attention of management right from the chief executive level to the bottom most worker level. These requirements and functions need to be standardized, monitored, analyzed and corrective actions prescribed from time to time. Hence the importance of maintenance audit is very much emphasized.

Maintenance Audit when properly and regularly conducted will have the following benefits:

- Helps in confirming, the function is performing towards the objectives that are set forth for it.
- To compare the performance indices of the function with that of the targets as well as similar benchmarks for the industry sector or with the world class best benchmarks.
- To identify weak areas for performance improvement and implementation strategies thereof.
- To get certified towards proper system functioning from the auditing agency which may be requirement of a statutory and standards agency
- To apply and obtain popular awards like the Total Productive Maintenance (TPM) award etc.

Activity A

Prepare a maintenance audit questionnaire for a small section of the factory you are familiar with.

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19.4 METHODOLOGY OF MAINTENANCE AUDIT

The steps in a maintenance audit are given below:

Initial Orientation: The auditing team has an initial meeting with the representatives of the company's senior management and the regulating agency, if any. In this meeting, the goals, scope and coverage, information requirement, schedule and the techniques of the audit to be employed are presented in a summarized form. The initial meeting enables both the auditing and auditee groups to understand each other's concern well and lays the foundation for a detailed interaction at later stages.

Preliminary Preparation: During this step, the auditors' team studies the management and technical information obtained in the initial orientation and prepares a plan for addressing the major concerns expressed by the company management or the regulator. Accordingly the most important areas of inquiry are identified and detailed audit visit plan and schedule are prepared. It covers the areas of audit, identification of management personnel to be interviewed, facilities and work areas to be visited, data requirements etc.

Preliminary Questionnaire Survey: The auditors prepare a detailed questionnaire on the various issues of concern in maintenance management and circulate in advance to the company management personnel. The questionnaire contains a systematic identification of elements and series of questions to collect information about the same. The questionnaire enables collection of documented information from a larger cross section of the target personnel. The answers to the questionnaire are compiled and conclusions are arrived at as to the selected areas and management personnel to be concentrated upon during the next steps.

Plant Visits: The auditing team undertakes a filed visit to the plant for collecting field information. During this visit, interviews are held with senior managers, supervisors, and technicians etc to obtain a first hand feeling of the management factors and concerns and feelings. During this visit, additional information required in terms of work processes, plant performance parameters, operation-maintenance interactions etc are also collected.

In some special audits, plant visits are also taken up to a comparable third party organization to make comparative analysis of the system and technical parameters. At the end of the plant visits, the auditing team would have the data essential to understand the companies maintenance strategies, challenges and plans. It also enables to fully understand the present resource structure in terms of the organization, manpower, budgets etc and its deployment.

Data Analysis: During this step of the audit, the study team reviews, digests, summarizes, and analyses all data and information gathered. Profiles of maintenance management performance are developed and compared to the company's past performance and to the performance of the industry and to similar companies. Many of the criteria used to evaluate effectiveness and efficiency can be measured quantitatively in terms of cost and savings, man-hours, percent adherence to schedule or budget, energy consumption, reliability, availability and so forth. However, truly comparable benchmarks may not be readily available. Accordingly, the auditor must consider the company's performance within the context of its unique environment. Seasoned judgment, both in tempering quantitative evaluations and in measuring less tangible performance factors must be used.

Development of Conclusions and Recommendations: Based on the above evaluation, the auditing team develops conclusions about the efficiency and effectiveness of the maintenance management system. The factors that were observed to be examples of good management practices are listed with supporting evidence and data and thus conclusions as to the strengths of the system are identified. Similarly, the possible sources of the problems are also identified, documented and possible consequences if these problems are not tackled are also listed. Alternative strategies to overcome the problems are identified and evaluated to indicate the most suitable option for problem solving.

Report Submission: The audit team prepares a comprehensive report indicating the scope of the audit, methodology adopted, information gathered, analysis performed and recommendations arrived at as a result of the audit. Normally, a draft report is submitted to ascertain the feedback of the company management and the final report

is submitted incorporating the suggestions and the feedback. The report submission is often accompanied by a direct presentation to the management/regulator agency where the action plans for implementation of the suggestions and the requirement of the involvement of the auditors further can also be discussed.

Activity B

Study the auditing standards of ISO 9000, 14000 etc and try to list similarities and differences between them and a 'Maintenance System' Audit.

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19.5 STUDY OF KEY RESULT AREAS

Maintenance management audit has to focus on both the results achieved and processes used to have holistic idea of the system efficiency and effectiveness. Given below are the major maintenance benchmarks, which need to be studied in the audit.

Maintenance Costs: Some of the major cost factors/ratios that need to be analysed are Total Maintenance Costs, Maintenance Cost To Budgets, Maintenance Cost For Unit Output, Maintenance Cost/Sales, Maintenance Cost/Asset Value and Contractor Cost Ratio to the Total Maintenance costs.

Maintenance Materials Management Performance: The factors/ratios related to maintenance materials (Spare parts) management performance are material consumption value to total maintenance cost value, inventory turnover, number of stock outs, material inventory value to equipment replacement value and purchase value to issue value.

Performance of Plant and Equipment Maintenance: The ratios that represent the plant and equipment maintenance performance are downtime ratio, spare parts/ consumables consumption ratio, redundancy in equipment, design life to replacement life ratio etc.

Maintenance Organization Performance: The organizational performance of maintenance management is measured by ratio of maintenance manpower to asset value, planned maintenance work to unplanned maintenance work, backlog by craft, maintenance to non-maintenance work, line to staff support ratio, percent jobs waiting, ratio of work order hours to standard hours etc. The customer service function of the maintenance department is measured by percent service calls attended, service response time, meantime to repair, and breakdown analysis reporting.

Maintenance Management Processes: Though maintenance benchmarks or performance parameters give the audit team a comparable idea about the status, due to the requirement of standard definitions for these ratios, sometimes it becomes difficult to draw careful conclusions. Hence the auditing processes now a days are concentrating on the process parameters to make evaluations more meaningful. These process parameters of maintenance management are listed below:

i) **Vision and Leadership**: In the modern strategy oriented management processes, it is needless to emphasize that policy and goals enunciated by a clear vision and leadership of the top management is very essential. The characteristics of the leadership that are looked for in an ideal situation are clear goals and targets, allocation of enough resources, commitment to continuous improvement programmes and leading by examples.

ii) **Maintenance Organizational Structure**: The nature and style of the organizational structure plays an important role in the efficiency and effectiveness of the systems. The characteristics that are seen of a proper organization structure are lesser number of hierarchies, clear roles and accountability, delegation, empowerment and multiskilling environment.

iii) **Spare Parts Management Process**: The importance of materials management for optimization of maintenance can be gauged from the fact that about 50 to 60% of the maintenance costs are consumed by maintenance materials. There should be proper systems and procedures for inventory control, spares classification and codification, vendor management and spares preservation and reclamation.

IT Systems Usage for Maintenance: The maintenance function has invariably taken the assistance of information technology (known as computerized maintenance management systems – CMMS). An audit will look for ideal features in the CMMS systems, the extent of use of the system and the utilization of its fullest capabilities.

Preventive Maintenance System: The use of preventive maintenance should be in a pro-active manner to identify and correct equipment deficiencies in advance rather than re-active problem solving. The PM system should be checked for optimum deployment of resources vis-à-vis achievement of targeted equipment availability.

Predictive Maintenance System: Use of modern condition monitoring systems and techniques like vibration analysis, infra red thermal inspections, ultrasonic, lube oil analysis are to be encouraged to dovetail the efforts of preventive maintenance systems to improve availability. Modern plants increasingly depend upon outsourced expert support for sophisticated predictive maintenance practices.

Maintenance Planning and Scheduling through Work Order System: The work order system, whether through computerized means or otherwise, should be carefully planned and implemented so that the system enables smooth performance of the maintenance requirements while simultaneously capturing necessary information for management analysis.

Operation–Maintenance Interface: Modern philosophies and techniques like Total Productive Maintenance (TPM) and Reliability Centered Maintenance (RCM) have made the requirement of Operation–Maintenance cooperation and interface an extremely important requirement continuous improvement and sustainable development.

Activity C

Carry out an audit of the maintenance management system of a small factory you are familiar with and suggest improvements in key result areas and processes.

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Activity 2

Nowadays technical executives feel that audits for energy, environment and maintenance should be integrated. Visit a plant you have access to and discuss the issue with the plant executives.

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19.6 CASE STUDY OF A MAINTENANCE AUDIT

A maintenance management audit was conducted in a chemical plant and the observations and recommendations of the study are presented below as a case.

Background of the Company: The company is one of the leading producer and exporter of Polyester Film in India with an annual installed capacity of of 15,000 TPA(Tons Per Annum). The company has also set up a facility for manufacture of Polyester Chips to meet the captive raw material requirements with an installed capacity of 15,000 TPA. The manufacturing facility is located at a populated state. It has an employee strength of about 350 at its works.

Scope and coverage of the audit: The scope and coverage of the audit are as follows:

- Maintenance Policy and Objectives
- Maintenance Organization
- Planning and Scheduling of Maintenance
- Monitoring and Control of Maintenance Performance Parameters
- Use of condition Monitoring for Predictive Maintenance
- Maintenance - Materials (Spare Part) interface
- Maintenance Craft Skill
- Training for Maintenance skill Upgradation
- Shutdown Maintenance/Overhauls

Methodology of the Audit: The following methodology was adopted to carry out the “Maintenance Audit” at the company.

- A Maintenance Audit Questionnaire was designed to collect details of the existing maintenance management system.
- Meeting with the Head of departments of the plant to apprise them about the study, the proposed methodology and action plan.
- Meeting with the sectional heads and other concerned officers to apprise them about the study so as to co-ordinate different activities and provide information pertaining to the audit. It also included visits to the respective sections to get first hand information of the process and nature of maintenance activities being carried out.
- Data collection including study of Process Flow diagrams, Machinery/Equipments used, Maintenance Policy statement, Maintenance documentation, Maintenance - Spares interface, Downtime analysis reports, Maintenance information system, Maintenance skill, etc.

- Audit of individual sections/departments by the audit team with the respective Section in-charges. It also included interaction with the shop floor employees.
- Detailed discussions and interviews with various officials in the plant including:
  - Senior executives regarding planning of production, maintenance, materials, manpower and their interface.
  - Mechanical executives regarding various aspects of Mechanical maintenance.
  - Instrumentation executives regarding Planning & Scheduling of Maintenance & Calibration, Diagnostics of failures etc for the instrumentation systems.
  - Electrical executives regarding maintenance of electrical systems including interlocks, trips, alarms, and their interface with the Mechanical maintenance.
  - Safety executive regarding accident statistics, conformance to various statutory provisions with respect to testing of equipment, tools & tackles etc.
  - HRD Executives regarding training and development activities.
- Formulation of recommendations based on the above audit.
- Brief presentation of the audit findings at the plant before top and senior management executives.
- Preparation and submission of the audit report.

Observations about the Present Maintenance System: The Biaxially Oriented Polyester film is manufactured from Polyester Chips. The process of BOPET film manufacture involves drying of the raw material (chips) in a crystallization dryer followed by Extrusion Filtration, Casting and Chilled Roll. This is passed through film manufacturing machine for stretching in Machine Direction Orientation (MDO) followed by stretching in Transverse Direction Orientation (TDO). The film so formed is trimmed on the edges. The finished material is passed through winder to form wound jumbo rolls. These rolls are cut to required sizes in Primary Slitter followed by secondary slitter, packing and dispatch. The scrap generated at various stages is sent to the recycling plant for reuse in the form of chips.

The main manufacturing/utility departments in the plant are:

- Manufacturing lines for BOPET films Line- 1
- Manufacturing lines for BOPET films Line- 2
- Chips plant
- Utilities plants separately for Line-1 & Line-2.
- Recycle Plants for Line-1 & line-2
- D.G. Power Houses separately for Line-1 & Line-2.

The Film plant is divided into two independent streams with separate equipments for each stream. Line No.1 has a production capacity of 6000 TPA while that for Line No.2 is 9000 TPA.

The company does not have any written Maintenance Policy or Maintenance Objectives. The maintenance objective as perceived broadly after visit to the plant and the discussions with various people is that of having minimum unplanned downtime irrespective of the cost, equipment efficiency, availability and maintainability performance.

The key process equipment, which governs the rate of production from the Film plant are Extruder, Chill Roll, and Winder & Slitter. These equipments are vital to the plant since these are high capacity, high cost, single stream equipment with no standby. In

addition, DG sets, which are supplying uninterrupted power, are also rated as critical equipments. The maintenance requirements of this equipment are one of the factors, which control the production scheduling. Recently the Production department has evolved a plan to allow a fixed number of hours annually for planned maintenance. The allocation of these hours is purely on experience base rather than the actual machine requirement basis.

The film plant operation is recently planned for about 51 weeks a year with the remaining time allocated for planned shutdown. There is a demand for the continuous operation of the film plant during the planned production schedule. The scheduling of planned shutdown is not quite defined in terms of frequency and time allocated for those frequencies. The plant is primarily stopped for major off-line jobs. These jobs are identified in advance based on the reports emanating from the shift working and daily inspections. The major jobs are planned and executed on an adhoc basis. The use of planning and scheduling tools such as Gantt chart, Bar Chart, PERT Networking is negligible. The day-to-day routine jobs and small minor jobs are scheduled during the general shifts by the section in-charges.

The maintenance strategy introduced recently in the plant involves three levels of maintenance as given below:

1. Preventive Maintenance
   - Daily routine activities
   - Minor repair jobs
   - Major repair jobs (on stand by equipment)
2. Breakdown Maintenance
3. Planned Shut Down Maintenance

The Preventive Maintenance activities are carried out by the Maintenance personnel with the help of recently developed equipment PM Check List by the respective departments. The various reports emanating from daily routine activities lead to planning of minor or major repair jobs. The defects or malfunctioning of the equipment are being reported by the Production personnel to the Maintenance personnel through phone, while maintaining such record in an informal register with them. The minor activities are scheduled on the same day or the next day based on their criticality. The major activities if not critical are scheduled as per convenience.

All the major maintenance activities requiring immediate attention and likely to take more equipment stoppage hours, manpower, repair time and materials are converted into Plant shut down as a short term measure. However, recently it has been decided to take an annual planned Shut down for about 10 days to attend the major preventive and corrective maintenance activities. Condition monitoring activity is in its primitive stage, though it could give valuable information on the imminent problems much in advance.

The routine maintenance jobs of minor nature are being carried out by the shift personnel while the repair jobs are carried out by the general shift and the overlapping shift personnel. The major jobs are carried out by the general shift personnel and the contract workers. Many a times the major jobs are contracted out. Additionally specific equipment maintenance jobs are carried out by the manufacturer’s/supplier’s personnel as per maintenance contract.

The material resources for major jobs are tentatively planned by the Sectional heads with information from the Stores Department and in consultation with the AGM (Process & Maintenance) and DGM (Production). Additional manpower is obtained from the contractor as and when required especially during the Breakdown Maintenance. The status of the spares is readily available on the computer monitor

through LAN. This computerized system is also used for indenting materials from the store. For material procurement through stores, the user department calls for quotations, evaluates them and gets approval from the competent authority. This is passed on to Purchase department for placing purchase order, procure the material and issue to the requesting department. The material procurement process by the user department involves precious maintenance man-hours, which has direct bearing on the maintenance of the equipment.

For routine and minor jobs no formal work planning is done. Only informal communication channels are used to get the job done. The activities are based on the recently developed Preventive maintenance checklists. The records of activities carried out are entered in shift register. Presently the shift register is maintained by writing the details of the work done in running text (Paragraph). It is difficult for any one to identified the details like nature of problem, corrective action taken, spares used etc. It is observed that some departments maintain two shift registers: one for the regular shifts and the other for General Shift. This procedure is likely to cause communication gap between the shift and G-Shift personnel.

The control mechanism for routine and minor maintenance activities is through entry in shift registers and an informal communication at different levels. The control mechanism also involves a routine daily meeting of sectional heads and above with GM (Works) to sort out day-to-day matters. The formal procedure of control uses data entry in Equipment Bin cards. The control mechanism for major jobs involves supervision by the sectional heads in co-ordination with AGM (Process & Maintenance)/GM (Works).

The maintenance function is decentralized with individual sections being looked after by separate Maintenance and the Production heads assisted by their respective teams. The present maintenance organization structure for individual sections is having 6-7 levels right from the HOD to the shop floor workers. Out of this the executives form 3 layers.

Recommendations of the Audit:

i) **Maintenance Policy & Objectives**

The suggested Policy and Objectives are given below:

Maintenance Policy

'We strive to achieve the highest level of Plant and Machinery performance with best Safety and Environmental standards. We are committed to maximizing plant availability by establishing efficient TPM practices, maintainability of plant and continuous improvement towards maximizing machinery Reliability and Safety.'

Maintenance Objectives

To achieve and maintain more than 95 % Plant Availability

To reduce the maintenance costs at the rate of 5 % per annum

To strive towards Zero Breakdown, Zero Defects and Zero Accidents through TPM.to encourage Total Employee Involvement.

ii) **Plant Unit Criticality**

A modified criticality plan considering Production, Maintenance, Quality and Safety aspects have been suggested. All individual equipments are to be subjected to this rating plan. Thus the equipment, after the rating exercise, would be categorized as Critical, Sub Critical and Non Critical categories. The Critical equipment will have a separate maintenance strategy incorporating Computerized Condition Based Maintenance programme, TPM — with emphasis on improvement of Overall

Equipment Effectiveness (OEE) & Reducing six major losses, and finally carrying out the Reliability Centered Maintenance (RCM) programme starting initially with top three critical equipment.

iii) **Planning & Scheduling of Maintenance**

It is strongly recommended to introduce computerization of Maintenance function so that data analysis and consolidated report generation is prompt and subsequently the management decisions. This would also help eliminate duplication of records.

Major Corrective/Breakdown jobs — For major planned repair jobs it is recommended to introduce the dynamic scheduling concept using Gantt charts and PERT charts. At a later stage the management may procure project management software to replace manual scheduling with computerized scheduling. It will help in minimizing the critical path, optimizing resources and keeping a close control on the complete job. The usage of this software can be made for all major planned repair jobs. For documentation purposes the existing Break down bin card may be replaced with the proposed work request form

Condition Monitoring — Must be carried out for all critical equipment. The proposed criticality plan may be used to identify additional critical equipment needing condition monitoring. Also, some more CM instruments may be procured to help reducing inspection times. Some of these CM instruments are:

Fiber optics for inspection of internal surfaces e.g. tubes, gear boxes etc.

Portable infrared scanners for inspection of all electrical systems including switchyards.

Wear particle/Lubricant analysis kit

iv) **Monitoring & Control of Maintenance Performance Parameters**

The following additional performance measures are to be introduced:

Detailed analysis of the data in terms of Equipment Availability, Overall Equipment Effectiveness [OEE], Mean Time To Failure [MTTF], Mean Down Time [MDT], Actual Repair Time, Mean Waiting Time [MWT], LCC, Reliability, Failure Rates, Spares consumption, Total Maintenance Cost Analysis including elemental level costs etc.

v) **Maintenance — Materials (Spare Parts) Interface**

It is recommended that a plant wide on-line integrated computerized maintenance system dynamically linked with the computerized stores/inventory (spares) management system and purchase function be developed for effective planning and scheduling of maintenance activities.

vi) **Maintenance Craft Skills/Training Needs**

Specific training on Tribology, Bearings, Gears, Belts, Pumps, Compressors, DG sets, Life Cycle Costing (LCC) to be included in the annual calendar of training programmes.

It is recommended to ensure that the contract workers are trained and are made aware of the various hazards/risks involved in their jobs, and on preventive and control measures.

Use of Video Cassettes outlining various activities of the company, various maintenance techniques, risk involved, necessary precautions to be taken, use of appropriate PPEs, provision of risk control measures existing in the plant etc., may be made during training programmes.

19.7 SUMMARY

In this unit the importance of maintenance management audit has been explained. The different types of audit that are possible in different situations and their applicability have been explained. The methodology adopted for conducting a maintenance audit also has been described with step-by-step approach. The importance key areas that need to be studied in a maintenance audit also have been brought out. Finally, a case study of a maintenance audit carried out in a chemical plant has been discussed. The maintenance audit is a powerful tool for the companies to identify their strengths and weaknesses and improvements required. It is expected that in the nearby future such audits would also be made mandatory considering the importance they can play in improvement of physical assets productivity.

19.8 REFERENCES

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19.9 SELF ASSESSMENT QUESTIONS

1. **Introduction**

   i. Why are audits important for management systems?

   ii. What is the main difference between audits for Safety and Maintenance?

   iii. State reasons for your opinion as to whether Maintenance Audit should be mandated by law or not.

2. **Types of Audit**

   i. State the different types of audits that are possible in an enterprise.

   ii. What are the major differences between a management audit and technical audit?

   iii. What types are overlaps you foresee between different types of audits? How these can be overcome?

   iv. Differentiate between a Preliminary and Detailed audit?

3. **Importance of Maintenance Audit**

   i. Why should the maintenance function be audited?

   ii. 'Maintenance Audit helps in analyzing performance factors and suggest improvements'— Explain this statement with some examples.

4. **Methodology of Maintenance Audit**

   i. Explain the steps involved in a ‘Maintenance Audit’?

   ii. What preliminary preparations are required before a maintenance audit can be commenced?

   iii. How can be questionnaire for ‘Maintenance Audit’ prepared?

   iv. What difference lies in the plant visits taken up at the auditee’s plant and a comparable plant?

   v. Describe the salient features to be covered in a maintenance audit report?

5. **Study of Key Result Areas**

   i. What are the key result areas that can be covered in a maintenance audit?

   ii. Give some indices for Maintenance Materials Management Performance?

   iii. What is the main difference of auditing result areas compared to auditing management processes?

   iv. What are the various maintenance management sub-processes and how an audit studies these processes?

19.10 ANNEXURE

Sample Maintenance Audit Questionnaire

1. Does a documented Maintenance Policy exist? (If yes, please attach a copy of it)
2. Where does the Maintenance policy find a place
   - Number of places in the plant
   - Only in selected company publications
   - Others (Pl. Specify)
3. What are the objectives of the maintenance function and what is the process of monitoring the realization of this objective within a time frame.
4. Give organization structure of the Unit and indicate how the various departments including Operations are linked with Maintenance Dept.?
5. Give the Organogram of the total maintenance department including electrical, Mechanical, Instrumentation, civil etc.
6. Give a diagrammatic sketch of the overall maintenance system. (Pl. use separate sheet)
7. List down all the sections and give the list of major equipments in each section.
8. Has criticality analysis been carried out and what is the scheme of classifying the equipment?
9. What is the key Maintenance Indices/parameters being calculated by the plant? Specify including their values for the past three years (1995-98).
10. Data required on other Maintenance indices:
    - Maintenance Cost
    - Plant Availability (%) - (section-wise) and Utilization
    - Maintenance overtime hours as a % of normal working hours section-wise for last three years
    - Value of consumables and spares consumed year wise for last 5 years
    - Maintenance man-hours per ton of Clinker and Cement
    - Ratio of value of maintenance spares/materials to the value of plant and machinery.
    - Ratio of Contract Maintenance Cost to the Total maintenance cost
11. Indicate the various maintenance documentation existing in the plant:
    - Total no. of machines and availability of O & M Manual for these machines.
    - Erection & Commissioning Drawings
    - Work Order System - Preventive Maintenance

- Breakdown Maintenance
- Major overhauls
- Condition Monitoring

- Planning & Scheduling charts (Including PERT charts for major overhauls)

  (Enclose filled-in formats of the above)

12. Is there a centralized maintenance-planning cell? If so, what are its functions?
13. How are the maintenance activities scheduled including scheduling of Manpower, Materials, other resources etc?
14. Whether standard maintenance jobs have been identified (machine wise, section-wise) and the time/other resources (tools/instruments/procedures) have been identified?
15. What is the system for following up pending maintenance activities and their related maintenance documents for the same?
16. Are History Cards maintained machine-wise/section-wise?
17. Give details of summary information (frequency and cost) from the history cards the various natures of failures for the past three years?
18. Give details of repair time machine-wise/section-wise for major failures.
19. Whether the maintenance function has been computerized. Pl. give the following details

    1. On what platform. (Operating System/Front-End Tools etc.)
    2. Network/Stand alone
    3. Number of Users and User ID.
    4. Various reports and queries generated (Pl. attach samples).

20. Whether the Spare parts/maintenance materials management has been computerized. Pl. give the following details

    1. On what platform. (Operating System)
    2. Network/Stand alone
    3. Number of Users and User ID.
    4. Various reports and queries generated (Pl. attach samples).

21. How the maintenance management system is linked with the spare parts management system. (Provide samples of filled-in documents)
22. How many occasions have plant been shut down due to non-availability of spares and what is the average length of times the plant was down.
23. How is the spares procurement done?

- Vendors Selection and Evaluation				
- Quality check - Specifications for spares - Preservation and Care				

24. How many training programmes are organized for the

		General Programme		Specific Programme	
1	Maintenance Executives	External	Internal	External	Internal
2	Supervisory Staff/Foreman				
3	Mechanics/Fitter/Electrician				
4	Workmen				

25. Provide the list of training programmes organized in last 3 years (category wise, section wise, skill wise, duration, course coverage)
26. Whether training need assessment is carried out and give details
27. Does the training for shop floor personnel include hands-on skill training
28. Educational qualification of maintenance technicians/workers (Please give break up)
29. How is shut down maintenance/overhaul planned?
30. Do you follow project management techniques such as PERT/CPM etc., and use computerized project management software? If yes, whether it is linked with the maintenance system.
31. Provide PERT charts/Bar charts for major shutdown maintenance/overhauls over the last 3 years.
32. What is the percentage of contract man-hours to the normal man-hours?
33. Give a brief write-up on the TPM practices adopted.