Loss Prevention Standards

Maintenance Regimes

Introduction

Implementing a proactive, well-managed and audited maintenance regime is an essential part of an organisation's capacity to operate successfully and reduce the potential of unnecessary interruptions.

Regulations place duties on organisations and individuals who own, operate or have control over work equipment, to ensure, amongst other things, that such equipment is safe and suitable for the use intended. The quality of maintenance is a significant factor affecting safety and operational costs, and an effective maintenance programme will ensure plant and equipment is ultimately more reliable.

To keep all businesses assets, such as buildings, equipment and machinery, plant protection and detection systems, etc., operating efficiently and reliably as intended, it is essential that regular inspection, testing, servicing and maintenance is carried out. As a minimum this should be as recommended by industry standards and manufacturer's/supplier's guidelines. This will help reduce unnecessary breakdowns, reactionary repairs, interruptions to activities, associated delays in the delivery of products or services to customers and costs to the business. Additionally, it will also assist an organisation in ensuring that its reputation is maintained, which is a major risk issue alongside traditional ones such as operational and financial.

Good, well-planned servicing and maintenance programmes enhance the overall risk management proposition of any company. Conversely, poor servicing and maintenance can result in equipment failures, shortfall in production and ultimately an impact on an organisation's financial performance.

The majority of companies have some form of maintenance programme in place. This may be limited to building repairs as part of the lease agreement; emergency breakdown repairs to plant or simple machinery; planned system testing of a building alarm installation; through to sophisticated and comprehensive levels of inspection, testing, servicing and maintenance required for complex equipment and systems.

For example, the consequences of poorly maintained buildings can result in:

- Falling masonry
- Failure of floor surfaces
- Damp/water ingress due to poor roof conditions
- Fire due to faulty electrical systems
- Partial building collapse
- Roof failures
- Faulty drainage systems
- Failure of the lightning protection system, etc.

Security systems designed to protect your business, can be compromised or impaired if not regularly serviced and maintained, increasing the threat to your business in respect of theft and disruption, along with any consequential losses. Similarly, inadequately maintained building and plant fire protection or detection systems could result in the systems not operating effectively, exposing the property and its occupants to greater risk.

Inappropriate or inadequate maintenance and inspection regimes can lead to outages that may compromise servicing commitments; cause expensive uninsured costs; generate insurance claims; and create ongoing issues with a supply chain, etc., which can directly affect an organisation's ability to operate effectively. Such failures could also result in criminal prosecution and fines being imposed on a company or individual.

Many countries have Regulations requiring examination, inspection and maintenance activities in respect of certain items of equipment, for example, in the UK, pressure systems and equipment, lifting equipment, local exhaust ventilation equipment and fixed electrical wiring.

As a condition of insurance, insurers often require regular servicing and maintenance of certain types of equipment/machinery, such as power presses and lifts. Failure to complete these may result in the costs of claims being reduced or even non-payment.

Inspection, testing, servicing and maintenance activities should only be completed by appropriately trained, qualified and preferably certified technicians, in accordance with agreed and documented procedures drawn up to suit the age, environment and operating conditions of the specific item. Records of all such inspections and maintenance activities should be formally recorded so that key parameters can be compared with previous records for trend analysis. This helps to identify and predict when a parameter is trending towards a failure condition, thus improving maintenance and asset replacement programmes.

Inspections and Testing

Various inspection and monitoring techniques are available and should be utilised in accordance with the manufacturer's recommendations for the item/object being inspected. In addition to the manufacturer's minimum requirements, the frequency of any activity should also be based on actual experience obtained of that item/object in situ, operating under the conditions it experiences over a period of time.

Inspection and testing technology is continually advancing, providing greater insight into equipment condition and service requirements when operational. Examples include vibration monitoring for detecting misalignment and loose components; ultrasonic/acoustic emissions analysis to detect small leaks/defects under stress conditions; thermography for non-intrusive testing methods of electrical systems.

The most appropriate technique(s) should be selected to help deliver greater reliability. It should be arranged to provide a deeper analysis on predicted failure rates of equipment, based on the in-service conditions and the time in service, etc. This will assist to reduce downtime, increase operational efficiency and reduce the risk of expensive, unnecessary or unrequired maintenance.

Maintenance Programmes

The four main types of maintenance programmes employed are:

- Preventive
- Risk Based
- Condition Based
- Corrective (Reactive)

Preventive

Maintenance undertaken which provides a proactive approach, with inspection, testing and maintenance regimes scheduled, based on the criticality of equipment and the risk of it failing. Preventive maintenance is performed before the equipment has broken down and at a frequency designed to protect equipment, improve its reliability and reduce the potential for system/production downtime.

Risk Based

Maintenance completed by prioritisation in respect of assets which provide a risk to the business, should they breakdown or fail. By integrating analysis and maintenance planning, based on the risk and consequences of failure, resources are focused on business important/critical equipment, which should be monitored and maintained more frequently.

Implementing a risk based maintenance process reduces the risk of failure in key areas, ensures high levels of reliability, safety and efficiency of such equipment, and helps lessen the overall risk to the organisation.

Condition Based

Maintenance strategy which is based on actual equipment performance monitoring. It uses repeated or continual analysis, employing recognised detection measures on operating parameters that signal or identify when the equipment is deteriorating, and the risk of failure increasing.

Inspection techniques include vibration monitoring, oil analysis, thermography and equipment observation.

Condition based maintenance is usually performed when specific indicators have recognised a decrease in the condition or performance of the equipment being monitored. It can be the most appropriate method of maintenance for high risk, critical, expensive or bespoke equipment.

Corrective

Maintenance programme which is reactive, requiring the repair or replacement of equipment and components, following a breakdown or failure. It presents an organisation with the risks of unplanned/unmanaged machinery and equipment downtime. This type of maintenance should be avoided for all equipment, but especially for any key systems or equipment which are considered critical.

What is a Good Maintenance Programme?

Maintenance activities should be the responsibility of a specifically named individual(s). To remove any potential conflict of interest, this individual(s) should not hold a managerial position relating to production or the principle activities of the business.

A good proactive servicing and maintenance regime will keep the business assets working correctly and operating within accepted tolerances. It will reduce unnecessary breakdowns and repairs, prolong the life of the business assets and reduce interruptions. It can also be used to monitor a wide range of business assets to reduce potential failures, which might affect operator safety or even start fires, etc. It will be formal, consistent and reliable 24 hours per day, 365 days per year.

The starting point for an effective maintenance system will be an understanding of what assets an organisation has and is responsible for maintaining. A comprehensive asset register and accurate formal drawings should be documented, forming the foundation of the programme.

Maintenance schedules and programmes need to be recorded and well planned. They should be based on risk assessments that consider actual experience, industry standards and the recommendations of manufacturers and suppliers. The risk assessment should have three principle focusses:

- The health and safety requirements of an item or system
- The statutory, jurisdictional and regulatory requirements for that item or system
- The resilience needed and the importance to the business activities. This can be in its inherent value, its lead time to replace, the impact to the business for the duration while it is compromised, etc.

There needs to be a robust task/action follow up and sign off to ensure that all work completed is satisfactory. Adequate numbers and types of spares must be held, particularly those that are considered critical or important to the business. These should be kept as per the manufacturer's recommendations, industry standards and based on actual experience, being stored away or segregated from the primary object that they would be used in/on.

A gap analysis needs to be completed by suitably trained and knowledgeable individuals, to review the inspection, testing and maintenance tasks, available spares and to establish 'Key Performance Indicators' (KPIs) to help prioritise tasks.

There should be a formal maintenance management system in place which is used to alert and record the required activity schedules; what type of inspection, service or maintenance needs completing; their priority; a summary of the task/work involved; the required date of completion; the actual completion date; the name of the company and or engineer who completed the work; a description of what they did and an area for formally recording any issues, faults, results, feedback associated with the task. It should also be able to record sudden failures and breakdowns. Ideally this should be an automated rather than a manual/ paper-based system. This could also be used for spares management. It should be able to provide appropriate management information to assess compliance, identifying any incomplete or missed activities.

A good management system is one that is easy to access, use, navigate and complete. It should automatically alert engineers/supervisors of upcoming inspections, servicing and maintenance events on various frequencies, e.g. daily, weekly, monthly, quarterly etc. The system should undergo regular management audits and be supported by occasional external independent third-party audits, to verify that the system is meeting its intended task and the KPIs are being achieved.

New, temporary or replacement machinery and equipment will need to be assessed and entered onto the servicing and maintenance programme and will require inspecting and checking prior to use. Essential spares must be re-assessed and updated on a continual basis.

If contractors/sub-contractors are being considered for some or all of the intended servicing and maintenance works, suitable quotations must be obtained. This should include providing satisfactory evidence that they are suitably trained, qualified and certificated to complete the intended works. Prior to accepting any quotation, it must be ensured that their insurance cover is adequate for the task as initially discussed and agreed with your insurer.

All contractors/sub-contractors' quotations for specific works must be to an agreed specification and standard, meeting the business requirements. Once accepted and inducted on any site, they must be adequately supervised, and the works inspected and recorded in the management system. There needs to be a formal way of identifying third parties in the maintenance management system, and any tasks completed by them should be formally and comprehensively recorded. It is essential that any third parties follow all site rules and procedures. You contract out the task, but you do not contract out the risk!

Items for Consideration

Examples are, but not limited to:

- Perimeter fences, gates, locking devices and locks, security lighting, closed circuit television (CCTV) cameras and systems, monitoring equipment, intruder alarm systems, access control systems and remote signalling systems, etc.
- Access roads, service yards, car park surfaces, external lighting systems.
- Fuel dispensing pumps, storage tanks, earth bonding connections, spillage containment bunds, weighbridges, drainage systems including surface water holding ponds, penstock valves and interceptor pits.
- Trees, landscaping and vegetation.
- Tanks and tank farms, tank supports and pipe brackets, valves, pipework, spillage containment systems, tanker loading and off-loading areas.
- Pipework and service gantries.
- External storage areas and bunkers.
- Building structures: walls, doors, windows, glazing, roofs, chimneys, drainage systems, transmission aerials and masts, stairs, hoists/lifts and lightning protection systems.
- Fire compartment walls, doors, dampers, shutters, fire stopping, fire resistive coatings, etc.
- Blast walls and explosion relief systems.
- Fire escape stairs.
- Doors and shutters (drop tests), door locking and latching systems (including safety interlocked systems).
- Solar panels and wind turbines.
- Vehicles and mobile plant (engines & fire protection systems, etc.).
- Electrical systems: transformers, power and lighting, substations, switchgear/controls, circuit breakers, emergency lighting systems, portable appliances, batteries and UPS systems etc. As electrical ignition sources are widely recognised as a leading cause of fire, the following should be considered as fundamental:
    - Dielectric fluid testing
    - Thermographic imaging etc. of electrical systems, motors, machinery, pipelines, valves, storage tanks, control panels, switchgear, transformers, bearings, conveyors, mobile plant, storage and buildings, etc.
    - Portable Appliance Testing
    - Fixed wiring tests
    - Exercising circuit breakers, etc.
- Standby generators: associated switchgear, control panels and fuel storage tanks.
- Spillage containment systems.
- Fire protection systems: automatic sprinklers, water spray deluge, valves, water monitors, tanks and fire pump sets, water mist systems, fire water systems, hydrants, dry and wet chemical systems, gaseous fire protection systems, portable and fixed extinguisher appliances, fire blankets, etc.
- Fire and security safety interlocks and signalling systems.
- Explosion relief, spark detection and suppression systems.
- Automatic fire alarms and detection systems, including fire safety interlocked systems, remote signalling systems.
- Boilers: flame failure devices, drop valves, cabling, fusible links, pressure relief valves, solenoid valves, shell and tube welds, expansion tanks and safety interlock systems, etc.
- Heating systems (building and process use).
- Stratification fans.
- Refrigeration systems and plant.
- Cooling towers and fan coil units.
- Racking and storage systems.
- Air compressors, pressure vessels, receivers, dryers, drain and pressure relief valves, etc.
- Ovens, proving ovens, coolers, mixers, conveyors and weighing machinery.
- Smoke extraction systems.
- Air conditioning systems.
- Ductwork fire dampers.
- Extract hoods/extract ducting systems (deep cleaning).
- Cranes and lifting equipment.
- Portable water supply systems, sluice gates, valves, filters, fittings, strainers, pipework & pumps.

- Escape of water, leak detection systems.
- Effluent water treatment and plant.
- Hot work, welding, cutting equipment and fume extraction systems, etc.
- Forklift trucks, mechanical handling equipment and battery charging.
- Bailing machines, shredding machines etc.
- Tools, machinery and plant, including bearings, etc.
- Production equipment.

Checklist

A generic Maintenance Programme Checklist is presented in Appendix 1 which can be tailored to your own organisation.

Further risk management information can be obtained from Aviva Risk Management Solutions

Appendix 1 – Maintenance Programme Checklist

Location	
Date	
Completed by (name and signature)	

	Maintenance Programme	Y/N	Comments
1.	Is there a manager responsible for the maintenance programme? If so, who is responsible?		
2.	Is there a formal asset register, and does in include all the following? • Buildings? • Services and utilities? • Plant and fire protection/detection systems? • Processing or manufacturing equipment? • Spares, etc.?		
3.	Are there formal up to date drawings for the: • Buildings? • Services and utilities? • Plant and fire protection/detection systems? • Processing or manufacturing equipment, etc.?		
4.	Have the buildings, objects, equipment, processes, utilities, activities, etc. on site been risk assessed to understand what are considered important to the site? Has the anticipated downtime, outage and recovery of these been assessed and is it considered acceptable to the organisation's risk appetite? Have these been specifically identified?		
5.	Have all statutory or regulatory required objects and systems etc. been identified, e.g. pressure systems, lifting equipment, DSEAR etc.?		
6.	Have any bottleneck, bespoke or long lead time objects/equipment been identified and their exposure quantified?		
7.	Is there an appropriate system in place for managing all inspections, testing, servicing and maintenance activities?		
8.	Is there an appropriate mechanism in place for ensuring the frequencies for inspection, testing, servicing and maintenance activities are appropriate, based on regulatory requirements, manufacturer/OEM, industry standards, site experience and learning, risk to the business, insurer, best practice ,etc.?		

	Maintenance Programme Contd.	Y/N	Comments
9.	Does the management system enable you to prioritise tasks? Who and how are priorities established?		
10.	Does the management system enable you to identify task completion rates, and measure this against the number of tasks due? • Based on the priority of the task? • Based on the total number of tasks? • Based on the length of time outstanding, etc.?		
11.	Does the management system enable feedback and recommendations resulting from a completed task?		
12.	Does the management system track any feedback and recommendations through to completion with periodic reminders? How are ownerships assigned?		
13.	Does the management system enable the completion rate of the task feedback/recommendations to be tracked? • Versus the total number of items raised in the system? • Versus the length of time since it was raised?		
14.	Does the management system enable trending of any parameters tested for specific tasks, e.g. temperature, pressure, moisture content, etc.?		
15.	Is the management system auditable? Are changes made to the system recorded in the system - date and by whom?		
16.	Are the task frequencies periodically audited to verify their applicability?		
17.	Does the management system enable you to identify and manage spares?		
18.	Have the types of spares needed and the minimum levels of these spares been identified?		
19.	Have critical, important or difficult to replace spares been identified?		
20.	Are spares stored In line with the manufacturers' recommendations?		
21.	Are spares stored in a separate fire area/building to the primary equipment they belong to?		
22.	Are spares for consumables stored in a separate fire area to equipment/production related spares?		

	Maintenance Programme Contd.	Y/N	Comments
23.	Is there a robust system to replace spares as soon as they are used?		
24.	Is there a separate capital expenditure budget set aside for maintenance activities and spares? How are replacement spares funded? Has an acceptable time been established for replacement of spares once used?		
25.	Are spares inventories audited?		
26.	Are any OEMs, service providers, or spares providers no longer trading? If so, what are the contingency plans?		
27.	Does the learning from any near misses, accidents, failures and incidents feed into the inspection, testing, servicing and maintenance management system? To help maximise leaning how is this formally and consistently completed? How is this shared amongst any other departments/locations within the group or company?		
28.	Additional comments:		