هيئة كفاءة الإنفاق والمشروعات الحكومية
Expenditure Efficiency & Projects Authority

National Manual of Assets and Facilities Management
Volume 6, Chapter 8

Mechanical Systems Maintenance Plan for Healthcare

Document No. EOM-ZM0-PL-000019 Rev 001

Document Submittal History:

Revision:	Date:	Reason For Issue
000	28/03/2020	For Use
001	18/08/2021	For Use

THIS NOTICE MUST ACCOMPANY EVERY COPY OF THIS DOCUMENT

IMPORTANT NOTICE

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1.0 PURPOSE

The purpose of this document is to provide the Entity and/or Facilities Management Company (FMC) with guidelines for the development of their Maintenance Management Plans for Mechanical Systems (MS) within healthcare.

This Plan provides examples of maintenance scheduling frequencies and advises best practice for Planned Maintenance (PM), Corrective Maintenance (CM) and Predictive Maintenance (PdM) tasks. This document is intended to:

- Impart knowledge that enables the Entities and/or FMCs a base structure from which they can develop a set of documents and procedures.
- Enable the Management, Senior Management and Engineers to have a clear understanding of the minimum maintenance requirements, along with Entity, Client, FMC, staff roles, and responsibilities.
- Identify the base analytical information that should be recorded by engineers and technicians to ensure discrepancies are pre-emptively identified and rectified through the maintenance management processes applied.
- Ensure that the use of mechanical systems for healthcare comply with the mandatory Royal Decree passed by the Saudi Council of Ministers. This stipulates that systems in the facilities are fully maintained, operated safely and are protected throughout their design life.
- Guide the Entity and FMC service providers on how to develop the Mechanical Maintenance Management Plans/Manual.
- Provide a structured flow and reliable reference points within the document that can be related back to the relevant sections.
- Give examples and guidance on how to formulate a bespoke set of documentation, developed against a What, Why, How, Who and When structure that includes the Shall, Should, Consider and Advise philosophy.

2.0 SCOPE

The scope of this document is to guide those responsible for ensuring that maintenance is carried out in a consistent and reliable manner by focusing on planned activities and the reduction of costly and disruptive reactive maintenance. The Entity, FMC, and/or the specialist service providers shall take steps to enhance the current practice of developing a maintenance plan for efficient building operations. A Planned Maintenance (PM) strategy is an ultimate goal to improve and optimize an engineering system and further reduce the risk of component failures.

A well written maintenance plan shall provide the Entity with a high level of confidence to safely and effectively execute maintenance and repairs in the applicable environments. The objective of this document is to direct maintenance from a standard minimum acceptable quality to a required consistent improved high level quality, through professional technical advice and instruction.

This document will address the following criteria of a maintenance management plan:

- **What** needs to be included - *formulated tasks against adopted standard*
- **Why** it should be incorporated - *standards, regulations, law, good practice, and efficiencies*
- **How** to build the document - *structure, process, guidance, and flow*
- **Who:** Roles and Responsibilities - *responsibilities for what elements, competence level requirements, and management inputs*
- **When:** Scheduled frequency - *required scheduled periods, PM intervals, and incorporated content. This is dependent on adopted standards, or best practice where these standards do not exist.*

Incorporated diagrams and/or flow charts are for guidance and should not be classed as all-inclusive but as elements that should be further developed as required. These should be in-line with the finalized document ensuring structured flow and reliable reference points that can be related back to relevant sections of documentation.

Entities and FMCs should be aware that the variants of facilities that the document covers may not include the equipment highlighted in this document, as a standard. Therefore, care around developing the bespoke maintenance plan is paramount.

Specialist healthcare facilities often include departments that will be equipped with or may be served by bespoke plant and equipment i.e. a University hospital (surgeon teaching facilities), healthcare research laboratory (Bio-hazard extract and Aseptic suite, with specialist infection and access control) or Palliative care (specialist environmental lighting) and Dialysis clinics (specialist environmental lighting and reverse osmosis (RO) plant). Therefore, Specialist Healthcare facilities are not covered within this document guide.

For Facilities that have such departments and/or plant/equipment, the development of the maintenance plan shall include cross-referencing to other specialist equipment/plant that may be found in other Facilities types and by referencing the specialist manufacturer O&M requirements.

This document also covers maintenance techniques to improve equipment and system-operating efficiencies and reliability in relation to improving utilities in existing and new buildings. Overall responsibility for the efficient maintenance management of the mechanical systems shall be under the overall control of the Entity and the Mechanical Safety Group.

For the purpose of this document a ‘healthcare facility’ has been defined as any location where healthcare is provided, such as but not limited to:

- Hospitals
- Clinics
- Nursing homes
- Dental care facilities.

Maintenance procedures covered within this document, relate to activities detailed through internal best practice, Original Equipment Manufacturers (OEM) guidelines, and industry best practice. Other strategies exist that may be of assistance to the Entity in completing maintenance activities such as thermographic surveys, vibration analysis, and spectrographic oil analysis. Adoption of alternative techniques must undergo a cost benefit analysis to ensure that it meets with the Entity’s aims and follows statutory/mandatory requirements imposed, added or amended from time to time.

3.0 DEFINITION

Term	Definition
Competence	The measure of ability to perform a specific task based on knowledge, judgment, experience, and skill
Corrective Maintenance (CM)	It is type of maintenance to performed on the systems, identification, isolation, and rectification of faults of systems equipment’s can be restored at working condition
Emergency Maintenance	Any (unplanned) maintenance activity that requires immediate repair due to potential/direct impact on public safety or business operation.
Entity	Means the Government Entity, authority, or ministry responsible for the Operations & Maintenance (O&M) works
Facilities Management (FM)	The organizational function which integrates people, place, and process within the built environment with the purpose of improving the quality of life of people and the productivity of the core business
Mechanical Systems	Assets with moving parts which are classified by the Entity as plant, machinery, or equipment

Term	Definition
Planned Maintenance (PM)	Scheduled maintenance routines, set out to ensure machinery, services and equipment are all maintained at regular intervals
Predictive Maintenance (PdM)	PdM is a method, used for systems maintenance to measurement of various parameters that show a predictable connection with the component life cycle and its associated subsystems.
Acronyms	
AE	Authorizing Engineer
ANSI	American National Standards Institute
AP	Authorized Person
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
BMS	Building Management System
CAFM	Computer Aided Facilities Management
CIBSE	Chartered Institution of Building Service Engineers
CM	Corrective Maintenance
CMMS	Computerized Maintenance Management System
COTS	Commercial off-the-shelf (parts)
CP	Competent Person
CSSD	Central Sterile Services Department
DCP	District Cooling Plant
FIST	Facilities Instructions, Standards and Techniques
FMC	Facilities Management Company
FOC	Facilities Operating Client
FOM	Facilities Operations Management
HTM	Health Technical Memorandum
HVAC	Heating, Ventilation, and Air Conditioning
JHA	Job Hazard Analysis
ME	Mechanical Engineer
MEWP	Mobile Equipment Work Platform
MS	Mechanical Systems
NFPA	National Fire Protection Association
O&M	Operations and Maintenance
OE	Operations Engineer
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PAR	Periodic Automatic Replenishment
PF	Power Factor
PdM	Predictive Maintenance
PME	Plant, Machinery and Equipment
PM	Preventative Maintenance
PTW	Permit To Work
RAMS	Risk Assessments and Method Statements
RCA	Root Cause Analysis
RO	Reverse Osmosis
SBC	Saudi Building Code
SOP	Standard Operating Procedure
STP	Sewage Treatment Plant

Term	Definition
UV	Ultraviolet
WTS	Water Treatment Systems.

Table 1: Definitions and Abbreviations

4.0 REFERENCES

- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society of Plumbing Engineers (ASPE)
- American Society of Sanitary Engineers (ASSE)
- Building Management System and Mechanical System Integration Guide
- Chartered Institute of Building Service Engineers (CIBSE) – Guide Mechanical Systems
- Facilities Instructions, Standards and Techniques (FIST)
- Health Technical Memorandum HTM 02-01
- Health Technical Memorandum HTM 04-01
- National Manual of Assets & Facilities Management (NMA&FM) – Volume 10, Health and Safety
- National Fire Protection Agency (NFPA) – NFPA70: National Electrical Code
- National Fire Protection Association (NFPA) – NFPA 72: National Fire Alarm and Signaling code
- National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code
- National Fire Protection Association (NFPA) – NFPA 90A: Standard for Installation of Air Conditioning and Ventilation Systems
- Expro National Manual of Assets & Facilities (NMA&FM) – Volume 5, Chapter 2: Seasonal Planning
- Saudi Building Code (SBC) – Mechanical Requirements 501
- Saudi Building Code (SBC) – Sanitary Requirements 701
- Saudi Building Code (SBC) – Fire Protection Requirements 801
- SFG-20 Maintenance Tasks Schedules
- The Occupational Safety and Health Administration (OSHA)
- National Manual of Assets & Facilities Management (NMA&FM) Volume 3, Asset Management

Note: International best practices and standards shall be selectively applied based on the evaluation of individual requirements. Where the standards stipulated conditions conflict, the most stringent shall govern, unless otherwise noted herein. When there is any conflict with the Saudi Building Code (SBC), only the Saudi Building Code will be applied.

5.0 RESPONSIBILITIES

Only trained and competent persons should be appointed by management to perform maintenance tasks on mechanical systems. Key personnel are described in the following table:

Role	Description
Mechanical Safety Group	The role of this group is to discuss current issues, solutions, and forthcoming potential problems (e.g., with new projects or dealing with new legislation), and to assist in avoiding project clashes, outages, and taking formulating mitigating actions
The Responsible Person (Director of Facilities)	The Responsible Person is employed directly by the Entity, and is the “Duty Holder” of the engineering systems and the staff who operate those systems. This person is overall responsible and accountable for the design, installation, Operation and Maintenance (O&M), and control of HVAC systems The Responsible Person has a legal responsibility to ensure that the Entity has complied with the relevant legal regulations pertaining to those engineering systems and the staff involved. The Responsible Person shall also ensure that the systems are kept up to date with the

Role	Description
	latest relevant legal regulations. This person shall not be the Authorizing Engineer (AE)
Facilities Management Company (FMC)	The FMC is an appointed client representative who in collaboration with the client controls the maintenance engineering departments, and is responsible and accountable for the Authorized Person(s) (AP) and Competent Person(s) (CP) as well as the site engineering systems, maintenance, and ensuring that control of those systems is in line with the client Standard Operating Procedure (SOP) for the maintenance activities
The Authorizing Engineer (AE) (independent)	AE is appointed by the Responsible Person (normally under the recommendation of the client) to take responsibility for the effective management of the safety guidance. The AE shall possess the necessary degree of independence from local management to take action where necessary and alert the Chief Executive (in the event where the local management do not take action to avoid harm)
Authorized Person (AP)	An individual who has been appointed by the Authorizing Engineer (AE) (or by an authorizing body within the Entity). AP shall be trained, competent, skilled, experienced, responsible, and has the necessary site knowledge to operate and maintain the system in a controlled and safe manner. The AP (V) is responsible for work or testing carried out on the system
Competent Person (CP)	An individual with the necessary training, and who has been appointed by an AP or by an authorizing body within the Entity, after conformation of competence, knowledge, skill, and experience. The CP can execute the required actions within a Permit to Work (PTW) and/or other directional documents as may be assigned to him

Table 2: Responsibilities

All personnel involved with maintenance of mechanical systems shall be mapped against a skills matrix as contained within Attachment 1. The skills matrix shall be used to establish competency levels and ensure appropriate governance

Figure 1 describes the process which maps above responsibilities to the action of planning and implementing PM.

Roles & Responsibilities for PM Scheduling and Implementation

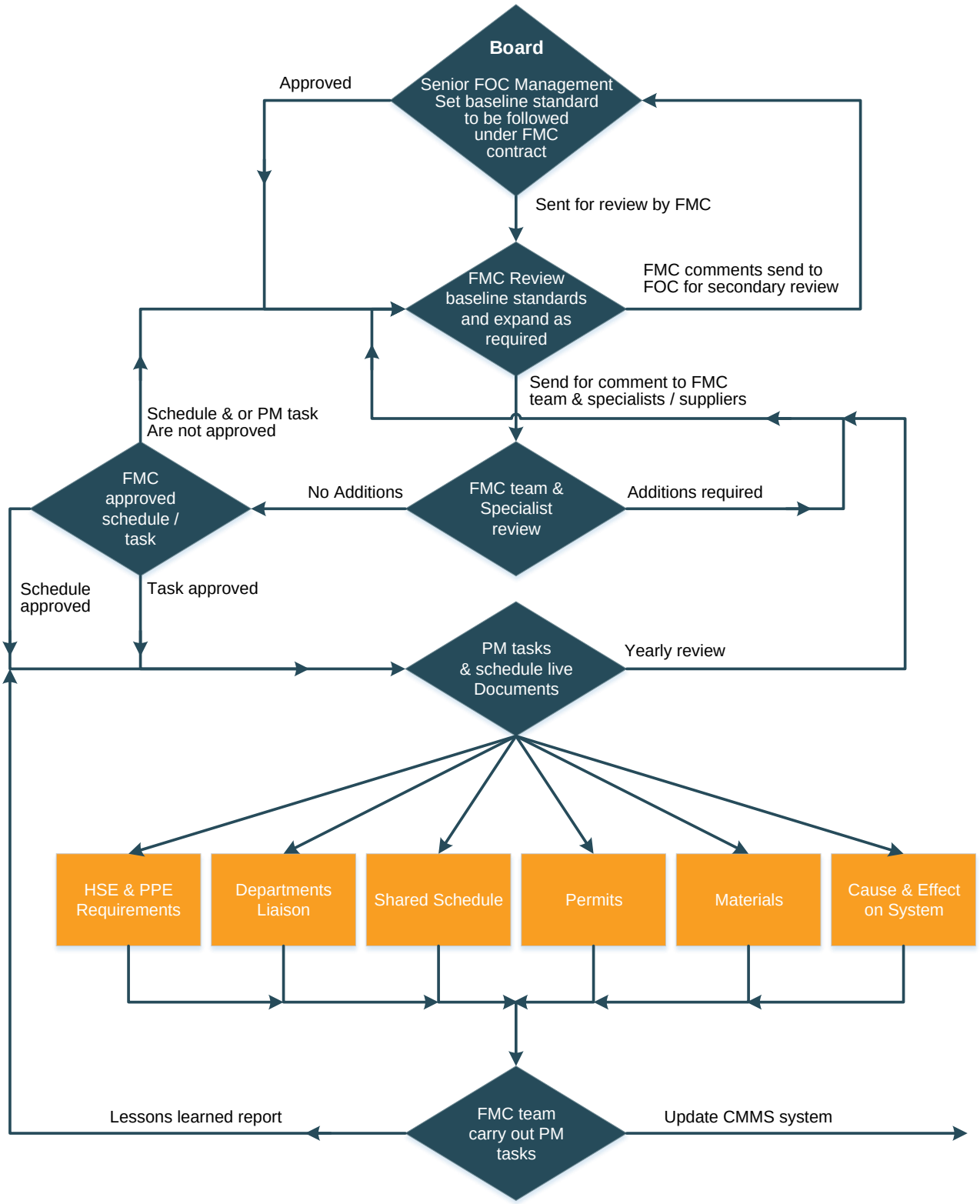

Figure 1: Roles and Responsibilities for PM Scheduling and Implementation

5.1 Maintenance Management – Mechanical Systems

Maintenance management plans involve the following:

- Health and safety refer to NMA & FM, Volume 10 – Health, Safety, Security, and Environment
- Maintenance plan standard requirements refer NMA & FM, Volume 6, Chapter 4 – Maintenance Plan Writers Guide
- Maintenance strategies refer to NMA & FM, Volume 6 Chapter 3 – Types of Maintenance
- Quality refer to NMA & FM, Volume 11 – Quality
- Risk management refer to NMA & FM, Volume 12 – Risk Management
- Technical Standards Engineering Delivery
- Work management center refer to NMA & FM, Volume 7 – Work Control

These elements shall address the criticality of asset and an inventory of material issues e.g., long lead items, specialty items, spares, critical spares, Commercial off-the-Shelf (COTS) parts.

5.2 Mechanical Safety Group (MSG)

The aim of MSG is to introduce a structured approach for the management of mechanical services specific PME in compliance with current Health Technical Memorandum (HTM) Standards and guidelines. While not a direct requirement of the healthcare facility, it is deemed as best practice to adapt the example mentioned below to suit the Entity's goals and objectives.

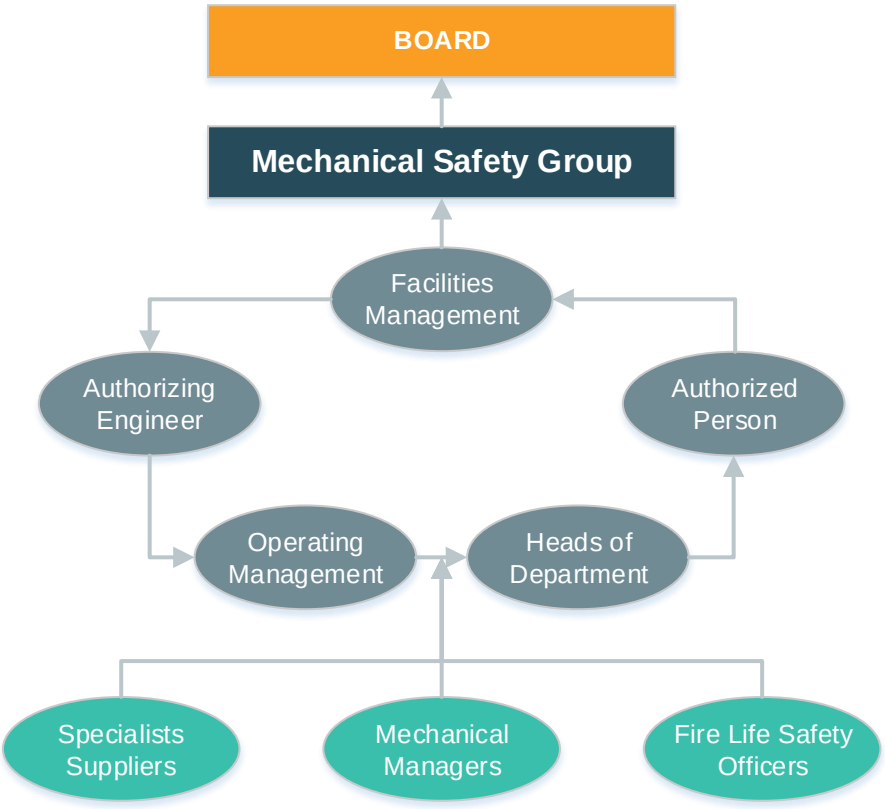

Figure 2: Mechanical Safety Group Organizational Structure

The reason for highlighting the organizational structure is to encompass those facilities, which may have a healthcare training, laboratory, or research element to their prospectus.

The primary purpose of the MSG is to guide stakeholders within the organization to implement a robust and measurable process for the safety and protection of those engaged in activities and the personnel (e.g., staff, patients, visitors) that may come into contact. For example, it must ensure:

- Health and safety of employees in the conduct of their work
- Health and safety of those coming into contact or may be affected by activities
- Legal and statutory requirements of the organization
- Adherence to local and organizational requirements/standards
- Safe and effective maintenance using best practice and approved spare parts
- Communication to stakeholders and users
- Training and development of service staff

6.0 PROCESS

Figure 3 describes components which should form part of a maintenance plan for mechanical systems. This section shall focus on key components, such as: Maintenance frequency, competency requirements, maintenance testing, Quality Assurance (QA), and Quality Control (QC).

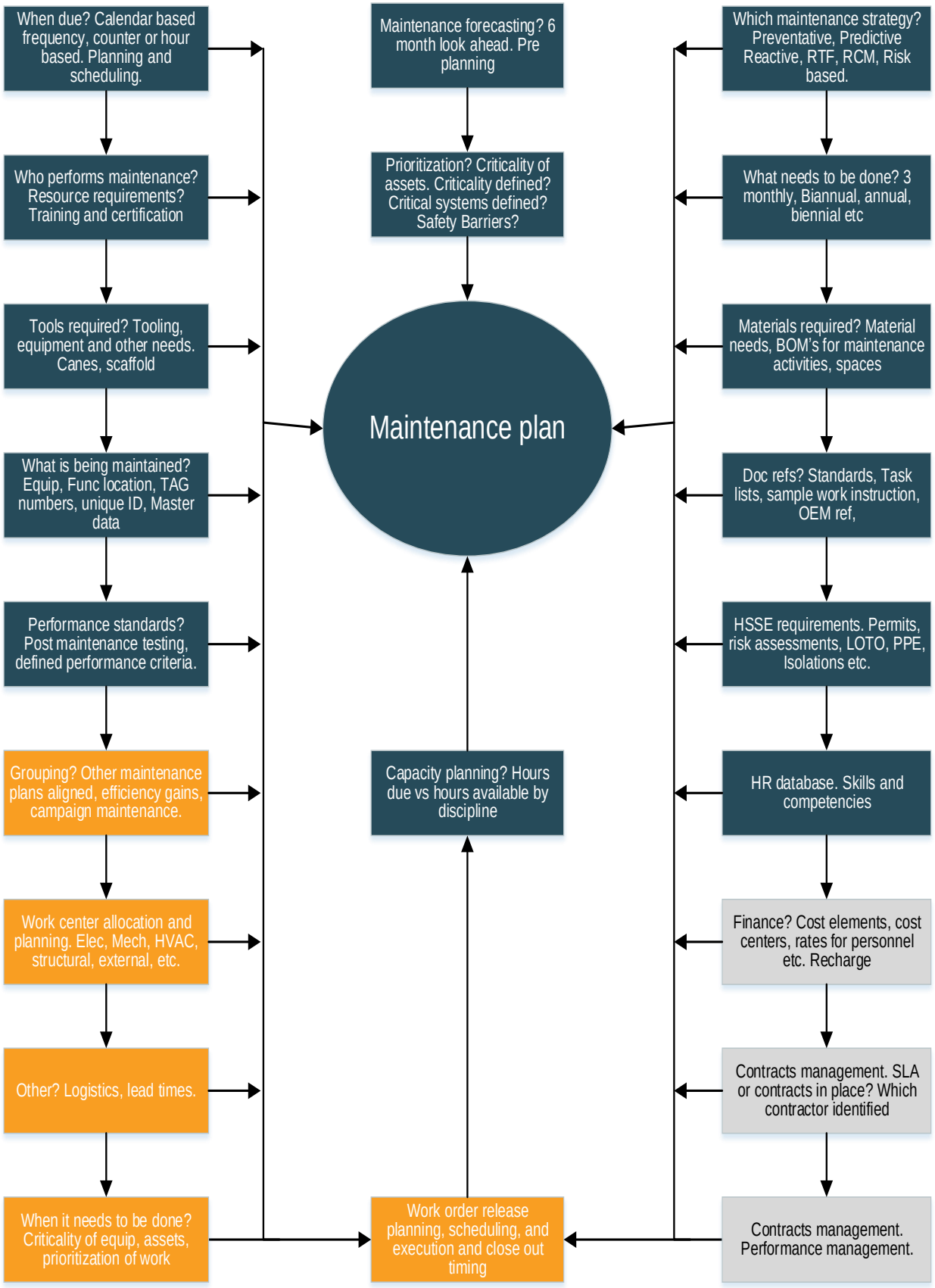

Figure 3: Maintenance Planning Element

6.1 Introduction to Mechanical Systems

Mechanical systems are assets with moving parts and are classified as plant, machinery, or equipment. Such systems therefore operate primarily on the principals of thermodynamics, fluid mechanics, and dynamic structures.

Due to their dynamic nature which require intensive energy use, mechanical systems can significantly impact energy efficiency and operating costs for healthcare facilities. While Facility Managers may not be directly involved in the actual maintenance of mechanical systems, their performance will directly affect the facility's potential. For example, increased inductance within the electrical distribution system caused by inefficient motor loads (e.g. primary and secondary water pumps) can significantly reduce Power Factor (PF), which in turn reduces power quality and increases facility operating costs.

Healthcare facilities will comprise of main mechanical systems and associated sub-systems.

Examples of mechanical systems typically found within healthcare facilities include:

- Water Treatment Systems (WTS)
- Plumbing Systems
- Fire Protection Systems
- Heating, Ventilation, and Air Conditioning (HVAC) Systems
- Generators/Fuel Systems
- Medical Gas Pipeline Systems (MGPS)
- Chiller Plants.

Examples of mechanical sub-systems include the following:

- Chilled Water Systems (Closed Loop Secondary Systems)
- Cooling Tower or Condenser Water (Open Loop Systems for Buildings)
- District Cooling Plant (DCP) Cooling Towers
- Hydrotherapy Pool Treatment
- CSSD RO Systems
- Dialysis RO Systems
- Steam Boiler Systems
- Domestic/Potable Water Systems
- Filtration/Ultraviolet (UV) System
- Neutralization Plant/Systems
- Chlorine Dioxide Generator Systems
- Grey Water Treatment
- Sewage Treatment Plant (STP).

Mechanical systems and associated sub-systems shall be inspected and maintained according to world-leading professional bodies such as: American Society of Mechanical Engineers (ASME); American Society of Plumbing Engineers (ASPE); and American Society of Sanitary Engineers Health Technical Memorandum (HTM) Types of Maintenance.

6.2 Types of Maintenance

Depending on the Entity's asset management strategy, organizational maturity and funding, the following types of maintenance may be applied to mechanical systems within each facility:

- Planned Maintenance: Preventive and Predictive (PM, PdM)
- Unplanned Maintenance: Corrective and Emergency (CM, EM)

This document focuses primarily on Planned Maintenance. Other maintenance types are described within NMA & FM, Volume 6 Chapter 3 – Descriptions and Definitions EOM-ZM0-PR-000002.

6.2.1 Planned Maintenance

Planned Maintenance is a regime that is carried out at predetermined intervals or frequencies on an asset to lessen the likelihood of it failing and to maintain the equipment's safe running conditions and efficiencies. PM is performed before equipment failure takes place and eliminates unexpected breakdowns.

Task Instruction sheets shall be prepared by each Entity as part of the planned maintenance regime to enable maintenance of mechanical systems – a sample is contained within Attachment 3

A Preventative Maintenance Program Procedure is provided within NMA & FM, Volume 6 Chapter 3 – EOM-ZM0-PR-000003.

6.3 Computerized Maintenance Management System (CMMS) Requirements

Each Entity shall employ a Computerized Maintenance Management System (CMMS) or other Expro-approved centralized system to capture maintenance plans and outcomes. The CMMS shall feature ability to set threshold values against system parameters and execute trend analysis. Mechanical systems maintenance plans captured within CMMS shall:

- Feature a list of tasks numbered by priority, and associated frequencies.
- Enable decision making which supports optimized system performance, maximizes equipment life, and offers energy and cost-saving opportunities.

Mechanical systems maintenance plans captured within CMMS should also:

- Refer to industry resources and feature site-specific guidelines to support maintenance activities
- Feature check points to enable Quality Assurance (QA); record sheets shall be attached to work orders to validate the results during testing and maintenance.

6.3.1 Record Keeping

Mechanical system design and performance information is important for effective maintenance planning, regardless of the maintenance activity being performed. Therefore, the Entity shall gather, upload and uphold all internal and 3rd party reports (e.g. from engineering studies, modelling, testing) associated with each system.

During normal operations, and emergency scenarios, the availability of as-built drawings is also crucial for understanding system design, maintenance approach, testing, and troubleshooting. Drawings shall also be stored in a centralized location with document numbering and control in line with ISO 90001: 2015 – Document Management System.

6.4 Maintenance Planning and Scheduling

The aim of maintenance planning for mechanical systems is to set out:

- What activities shall be undertaken
- How the activities shall be undertaken
- How long each task shall take to be completed?

A comprehensive Maintenance Schedule shall be developed by Maintenance Planners within each Entity, featuring the following as a minimum:

- Start date and time
- End date and time
- Planned duration
- Required parts
- Responsible personnel
- Assets to be maintained

- Maintenance activities to be executed and their associated type code (e.g. EM, CM, PdM, PM)

Maintenance schedules shall be based upon several inputs, including; cross-department recommendations, O&M team individual experience, equipment history, and OEM recommendations. Maintenance Planners shall collaborate with internal and external stakeholders (as applicable) to achieve an optimized maintenance schedule.

Frequency of maintenance is a critical aspect of maintenance planning for mechanical systems. Frequency of maintenance should range, for example: from daily checks, up to up to major overhauls on a 5-yearly basis.

During the planning of maintenance tasks, a cause and effect matrix shall be prepared to comprehend the full impact of maintenance on operations within the healthcare facility. This exercise may be captured within the Risk Assessment Workshop described within Section 6.9.

Further guidance is provided within NMA&FM Volume 6, Chapter 7 – Requesting, Prioritizing, Scheduling and Planning Work – EOM-ZW0-PR-000001.

6.5 Quality Control and Quality Assurance

Quality Control (QC) represents the quality standards which shall be met by each Entity, however, Quality Assurance (QA) is the method which checks that quality standards are being met and captures opportunities for continuous improvement.

QC shall be determined by the content of mechanical systems maintenance plans, for example:

- Actions to be undertaken through maintenance are based on system-specific and site-specific performance data
- Frequency of maintenance is based upon OEM recommendations
- Data point thresholds which are set up in CMMS and used for refining maintenance plans.

QA should be determined using a number of techniques and data analysis, for example:

- Findings deduced from CMMS data trending
- Checklists designed for each maintenance activity
- Permit to Work (PTW) which ensures safe procedures that protect people from the system, but also limits human error by removing single point of failure through involvement of an Authorized Person.

6.6 Spare Parts

Spare parts are components featuring an asset tag which are used to replace damaged, expired, or failed parts of mechanical systems. However, consumables are those which are not assigned an asset tag but are required to enable mechanical systems to operate (i.e. fuel oil for diesel generators, and chemicals for the chemical dosing system).

Each Entity shall ensure that a Bill of Materials (BOM) is established for all mechanical systems. An asset hierarchy shall be established with equipment criticality identified in order to inform:

- Maintenance strategy
- Spare Parts List
- Running arrangements
- Risk assessments.

A sample Equipment Criticality Matrix is provided in Attachment 2 to support the process of assigning criticality.
The BOM shall include the following as a minimum:

- Part number
- Make and model
- Quantity
- Replacement cost
- Asset ID and location indicator.

The BOM should become part of the CMMS to enable centralized storage and retrieval of asset data for mechanical systems. However, in case of unavailability of CMMS, a soft copy of the BOM shall be available with facilities management team which shall determine Periodic Automatic Replenishment (PAR) levels.

An inventory control process shall govern the procurement and installation of critical and non-critical equipment. The following elements shall be considered while developing BOM:

- High cost spares/consumables
- Long lead items
- Items obsolete in market
    - Replacement of components which are no longer in production by the Original Equipment Manufacturer (OEM) according to the original specification shall be assessed carefully without compromising quality, efficiency and Process and Instrument Design (P&ID) functions
- Equipment duty
- Main and back-up arrangements
- Alternate material selection options
- Technical Specifications

Parts with high failure rate shall be highlighted through maintenance activities and further analysis shall be performed to identify Root Cause Analysis (RCA) of component failure.

6.7 Maintenance Testing

The Entity's asset management strategy, performance requirements, organizational maturity, and funding are factors which dictate the Entity's approach to maintenance testing.

Post Maintenance Testing (PMT) should be performed as required following execution of maintenance activities. NMA&FM Volume 6, Chapter 27 of the NMA&FM – PMT Procedure (EOM-ZM0-PR-000008).

6.8 Health and Safety

Maintenance of mechanical systems holds inherent hazards due to proximity of energized equipment and moving parts. Maintenance activities which pose significant risk to people and to mechanical systems are non-routine maintenance tasks, and those which involve exceptional working conditions such as confined spaces.

Regardless of the maintenance activity being undertaken, human error is a factor of maintenance activities which is most likely to lead to near misses, accidents, and system malfunction. Given that the mechanical systems drive HVAC within all healthcare facilities, scheduled maintenance during summer months, for example, requires activities to be executed such that downtime is minimized. CM executed during the same period should be assigned the highest priority level to prevent discomfort to building users, or damage to building fabric.

Maintenance personnel are therefore required to plan maintenance appropriately based on analysis of system data and performance history, then work to reduce risk to people, systems, and the environment.

6.9 Risk Management

The maintenance team shall complete a comprehensive set of Risk Assessments and Method Statements (RAMS) covering each mechanical system within the healthcare facility. For task-specific activities, a Job Hazard Analysis (JHA) shall be conducted, using the content of RAMS as a basis for the JHA. Visitors, contractors, and others working under site specific Health and Safety plans shall all be included within all RAMS and shall sign onto the JHA as required.

The below elements shall be considered when carrying out Risk Assessments for mechanical systems maintenance:

- Identify hazards associated with each maintenance activity, for example: loss of critical systems (e.g. HVAC and water)' impact on operation of facilities and equipment failure
- Establish maintenance personnel, service providers, and building users who are at risk as a result of the maintenance activity
- Quantitatively evaluate risks using a risk matrix (involve maintenance team, subject matter experts, and HSSE team in risk assessment process and hold a Risk Assessment Workshop as necessary)
- Take action and decide on mitigation measures needed, required investment, responsibilities and timelines
- Review the risk evaluation following implementation of mitigation measure
- Record findings.

7.0 ATTACHMENTS

1. Attachment 1: EOM-ZM0-TP-000021 - Skill Level Matrix Mechanical Systems – Healthcare
2. Attachment 2: EOM-ZM0-TP-000022 - Equipment Criticality Matrix Mechanical Systems – Healthcare
3. Attachment 3: EOM-ZM0-TP-000023 - Task Instruction Sheet Mechanical Systems – Healthcare

Attachment 1 – EOM-ZM0-TP-000021 – Skill Level Matrix Mechanical Systems Healthcare

NOTE:

This matrix is for guidance only and should be developed further by the Entity to meet site-specific system-level and competency-level requirements.

In-House Skill:

Level 1 – Manufacturer Trained and/or Engineer
Level 2 – Certified Discipline Trained
Level 3 – Competency Assessed Operative
Level 4 – Assessed Helper

Specialist Skill:

Level 1 Specialist – Life Safety Licensed Company and Operatives
Level 2 Specialist – Manufacturer/Manufacturer Trained and Certified

Type of Maintenance Task	Service Provision by:		Required Competency Level
Mechanical Systems	**In-house**	**Specialist Supplier**	**In-House Skill Level 1 – 4, or Specialist Skill Level 1 – 2.**
Water Treatment Systems/Plants	☑	☑	
Life Safety Systems		☑	
Plumbing Systems	☑		
HVAC Systems	☑		
Generators/ Fuel Systems	☑	☑	
Medical Gas Systems		☑	
Chillers Systems	☑	☑	
Water Treatment System	**In-house**	**Specialist Supplier**	
Chilled Water Treatment	☑	☑	
Cooling Tower/ Condenser Water Treatment (Open Loop Building)	☑	☑	
DCP Cooling Tower (Community)	☑	☑	
CSSD RO Plant Treatment	☑	☑	
Dialysis RO Systems (Potable RO)	☑	☑	
Hydrotherapy Pool System	☑	☑	
Steam Boiler System (Laundry)	☑	☑	
Potable/Domestic Water System	☑	☑	
Filtration Systems (UV Systems)	☑	☑	
Neutralization System/Plant	☑	☑	
Gray Water Systems	☑	☑	
Sewage Treatment Plant	☑	☑	

Attachment 2 – EOM-ZM0-TP-000022 – Equipment Criticality Matrix for Mechanical Systems Healthcare

NOTE:

1. This matrix is for guidance only and should be developed further by the Entity to meet site-specific system-level and competency-level requirements.
2. Assigning criticality of assets, and standards compliance remains the responsibility of each Entity.

Description			System Equipment Category					Type of PM included in plan					Compliant to	Frequency
ME Systems	Sub-System	Equipment	Life safety	Critical	Essential	Utility	Non-Essential	Compliance	Standard	Regulatory	Manufacturer	Best Practice	Technical Standard	Site Specific FQ
Water	Chilled water	Automatic dosing systems	X	X					X		X	X		
	Cooling tower	Automatic controllers	X	X					X		X	X		
	DCP cooling tower	Sensors	X	X					X		X	X		
	CSSD RO	Multimedia filters	X	X				X	X		X	X		
	Dialysis RO	Control panels	X	X					X			X		
	Hydrotherapy pool	Test kits	X	X					X	X		X		
	Steam boiler	Carbon filters	X	X					X	X		X		
	Potable/domestic water	Filter housing	X	X				X	X	X	X	X		
	Filtration system	Water softeners	X	X				X	X	X	X	X		
	Neutralization system	Membranes	X	X				X	X	X	X	X		
	Gray water system	Pressure vessels	X	X	X	X	X		X	X	X	X		
	Sewage treatment Plant	Air blowers	X	X	X	X	X		X	X	X	X		
Plumbing	Potable cold water supply	Hot and cold mixture	X	X	X	X	X		X	X		X		
	Hot water supply	Valves	X					X	X	X	X	X		
	Drainage venting	Water meters	X					X	X	X	X	X		
	Water heater	Isolation valves	X	X				X	X	X	X	X		
	All types of pumps	Butterfly valves	X	X	X	X	X		X	X		X		
Life safety S/M	FM200	Hose reals	X	X	X	X	X		X	X	X	X		
	Fire Alarm	Fire pumps	X	X	X	X	X		X	X		X		
	Fire extinguishers	Fans and dampers	X	X	X	X	X		X	X	X	X		
	Sprinklers	Exist signage	X	X	X	X	X		X	X	X	X		
	Emergency lighting system	Manual call panel	X	X	X	X	X		X	X	X	X		
HVAC System	Central heating and cooling	Direct Expansion (DX)	X					X	X	X	X	X		
	Air distribution system	Variable-refrigerant Flow	X					X	X	X	X	X		
	DX units	Variable Air Volume (VAV)	X					X	X	X	X	X		
	Split units	Constant Air Volume	X	X	X	X	X		X	X		X		
		Roof Top Units	X	X	X	X	X		X	X		X		
		Air Handling Units	X	X	X	X	X		X	X		X		
		Fan Coil Units	X	X	X	X	X		X	X	X	X		
		Hybrid Heat Pump	X					X	X	X	X	X		
		Local Exhaust Ventilation	X					X	X	X	X	X		
Generators	Generator control unit	Diesel Tank	X					X	X	X		X		
	Internal combustion engine	Filters: air and fuel	X	X	X	X	X		X	X	X	X		
	Starter motor	Control panel	X	X	X	X	X		X	X		X		
	Alternator	Controllers	X	X	X	X	X		X	X		X		
Medical Gas	Electrical System	Vacuum Pumps	X	X	X	X	X		X	X	X	X		
	Automatic Transfer Switch	Gas and Vacuum Shutoff	X					X	X	X	X	X		
	Emergency System	Pressure gauges	X					X	X	X	X	X		
	Life Safety Systems	Gas cylinders	X		X			X	X	X		X		
	Critical System	Pressure and Vacuum	X		X									
	Vacuum Systems	Oil indicators	X		X					X				
	Central Supply System	Pressure indicators	X		X					X				

	Electrical Power and Control	Moisture indicators	X				X			X		X		
	Medical Air Quality Monitoring	Circuit breakers	X				X			X		X		
	Surgical Vacuum Supply	Control Panels	X				X			X		X		
	Medical Air Compressor		X		X		X		X	X	X	X		
	Communication systems		X		X				X	X	X	X		
	Life safety systems		X		X			X	X	X	X	X		
	Dental Gas and Vacuum S/M		X		X			X	X	X	X	X		
	Incident Command System		X		X			X	X	X	X			
Chillers	Cooling towers	Automatic dosing systems	X		X			X	X		X			
	Compressor	Pumps	X		X	X		X	X		X			
	Evaporators	Pressurization unit	X		X	X		X	X			X		
	Condensers	Control panels	X		X	X		X	X			X		
	Refrigerants	Control valves	X		X	X		X		X		X		
	Heat recovery systems	Bypass valves	X							X		X		
	Control Systems		X							X		X		
	Hydronic distribution systems		X							X		X		

Attachment 3 – EOM-ZM0-TP-000023 – Task Instruction Sheet for Mechanical Systems Healthcare

An example Task Instruction Sheet for Boiler Systems is featured below. The Entity should use it as a basis by which to develop its own site-specific Task Instruction Sheets for Mechanical Systems.

Skill Types

ME – Mechanical Engineer
EE – Electrical Engineer
IC – Instrumentation and Control Engineer
CE – Civil Engineer

Boiler Systems			
Item	**FQ**	**Action**	**Skill Types**
Water gauge test	Daily	NA	ME
Water level left & right hand gauge		Manual blow down	ME
Water Level Control		Test low water level cut-out and lock-out.	ME
Feed pump start/stop or modulation		Check operation	ME
Pressure readings		Record the pressure gauge reading	ME
PH and TDS water Test		Carry out TDS water quality test, record the result and make Adjustments where necessary	ME
Blow Down		Record quantity of water blown down.	ME
Feed water and condensate check		Check the feed tank level is adequate and there are no contaminants. Check that the chemical dose metering device is functioning and there are adequate chemical stocks in the tanks. Check that the in-house routine sample results are within their given parameters provided by the water treatment specialist and take remedial action when necessary. Check the temperature is above the required level for the treatment doses specified for oxygen scavenging.	ME
Flame failure	Weekly	Test flame failure lock-out. This may not be present on non-self-monitoring boilers	ME
Failure to ignite.		Test failure to ignite lock out	ME
Water level 1st.		Test by lowering water level to 1st low water level, by evaporation and controlled blowdown, and check burner locks out and the alarm is sounded	ME
Water level 2nd.		Test by lowering water level to 2nd low water level, by evaporation and controlled blowdown, and check burner locks out and the alarm is sounded	ME
Isolation from electricity supplies	Monthly	Switch and lock off. Remove fuses from both supplies.	ME
Water treatment		Ask if the system has been drained since last visit and if it was retreated with inhibitor.	ME
Water checks		Leakage checks	ME
Fan cooling air duct		Remove button front casing clean duct through casing, remove the rear end fan motor which is exposed when the casing is removed.	ME