National Manual of Assets and Facilities Management
Volume 6, Chapter 10

Communication Systems Maintenance Plan for Healthcare

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1.0 PURPOSE

The purpose of this document is to provide an Entity or Facilities Management Company (FMC) guidelines for the maintenance, improvement, and further enhancement of their maintenance management plan for communication systems within the healthcare sector. The guidelines incorporated into this document will further support The Entity and/or FMC to improve and enhance the overall condition of communication systems that fall under the remit of The Entity. In addition, best practices are intended to enable a structured approach in order to develop communication systems maintenance plans.

2.0 SCOPE

The scope of this document is the infrastructure contained within the facility that will allow data, voice, and digital networks to operate within the facility. It is not the intention to deal with the individual intricacies of individual systems, as this would generally be undertaken by specialist service providers. Therefore, the systems that an Entity would expect to see within a facility are highlighted here and guidance provided for the effective maintenance of these systems to maintain a high level of efficiency and reduce disruption. See Table 1 below.

The communication assets in Table 2 are internal assets supported by the core assets, which are maintained by the Entity. However, the internal communication assets and specialist systems services are provided and maintained by the Information Technology (IT) department or 3rd parties. This document is primarily concerned with infrastructure core assets and shall focus on required planned maintenance regimes.

This document provides information developed from international standards and best industry practices to develop, improve, or enhance the maintenance plans within a “Health care” Entity. Furthermore, it will support the Entity for a better understanding of the following:

- Elements involved in maintenance planning of the communication systems
- Maintenance tasks management and execution to optimize communication systems efficiency
- Quality Assurance and Quality Control (QA/QC) of the maintenance tasks
- An improved Communication and associated equipment’s efficiencies

For an engineering system to be efficient and utilized to an optimal life cycle, a ‘Conduct of maintenance’ shall be established to effectively maintain communication assets and equipment.

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

The maintenance of the core infrastructure communication assets below shall be managed by the Entity. The infrastructure assets are expected to support the internal assets as mentioned in Table 2. These are to be considered depending on location and requirements.

Assets List	Comments
Lease lines	
Tunnels from street levels to communication room	
Communication Room – Access Control	Covered in document EOM-ZO0-PR-000040
Uninterruptible Power Supply (UPS) – installed by landlord/Tenants	Covered in document EOM-ZM0-PL-000025
HVAC	Covered in document EOM-ZM0-PL-000019

PSNT	
Communications lines	
Data cables	
CCTV	Covered in document EOM-ZM0-PL-000037
PAVA	Covered in document EOM-ZM0-PL-000043
Communication Risers	
Routers	
Fiber and Analogue within the building	
Digital Audio Radio Service (DARS)	
Building management office	
Telephone infrastructure	
Lifts communication – Auto dialer	Covered in document EOM-ZM0-PL-000061
Data connectivity management systems	

Table 1: Core Assets Internal communication assets as mentioned below shall be the responsibility of the IT department or 3rd Party suppliers.

Assets	**Maintenance Responsibility**
Telephone Systems	IT or 3rd Party responsibility
Network Systems Infrastructure	IT or 3rd Party responsibility
Nurse Call System	IT or 3rd Party responsibility
Wi-Fi Network	IT or 3rd Party responsibility
Pagers	IT or 3rd Party responsibility
Integrated communication services	IT or 3rd Party responsibility
Patient monitors	IT or 3rd Party responsibility
Digital networks	IT or 3rd Party responsibility
Teleconsultation	IT or 3rd Party responsibility
Televisions	IT or 3rd Party responsibility
Intercom	IT or 3rd Party responsibility
Staff communications base	IT or 3rd Party responsibility
Patient-to-nurse (non-speech)	IT or 3rd Party responsibility
Audio Alarms	IT or 3rd Party responsibility
Videoconferencing	IT or 3rd Party responsibility
Radio services	IT or 3rd Party responsibility
Nurse-presence system	IT or 3rd Party responsibility
Security of communication	IT or 3rd Party responsibility
Staff-to-staff (emergency)	IT or 3rd Party responsibility
Pocket pagers	IT or 3rd Party responsibility
Intruder alarm	IT or 3rd Party responsibility
Cardiac alarm	IT or 3rd Party responsibility
Attack alarm	IT or 3rd Party responsibility
Headsets	IT or 3rd Party responsibility
Pull cord units	IT or 3rd Party responsibility
Mimic Indicators	IT or 3rd Party responsibility

Table 2: Internal Assets – IT or Third-Party responsibilities

3.0 DEFINITIONS

Term	Definition
Basis of Design (BOD)	A mandatory generated pre-construction document based on American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), Leadership in Energy and Environmental Design (LEED), and National Fire Protection Association (NFPA) that is used to prepare the Mechanical, Electrical, and Plumbing (MEP) system's manual and commissioning documents
Best Practice	A method or technique that has been generally accepted as superior to alternative practices because it produces better results than those achieved by a standard way of doing things (e.g., a standard way of complying with legal or ethical requirements)
Calibrated Tools	Measurement tools that have a calibration requirement, either as a statutory or risk-assessed requirement
Consumable	Physical part of an engineered system, Personal Protective Equipment (PPE), or a cleaning, treatment, or preservative liquid or compound whose consumption or use as part of a maintenance task is necessary and predictable
Criticality	Typically, a 4-5 level ranking system that categorizes the importance of the component, asset, or maintenance task. Refer to Volume 2: Asset Management
Data Point Schedule	A table format which shall show the monitoring and control points for the equipment and system. Points such as control and monitoring as I/O points (Input and Output points, to and from the controller)
Facility	The term for the group of fixed civil engineering assets which are not a building. For example, a bridge, a mast, a harbor
Frequency	Refers to a cyclic time period
Maintenance Program/Schedule	Same as schedule. Refers to the time basis of the delivery activity
Monitor/Head end PC	See engineering equipment's systems status for monitoring and control of operations
Parameter	The name of a unit or metric. For example, pressure, hertz, temperature
Point of Work Risk Assessment (POWRA)	A short checklist that operatives refer to at the 'location of' and immediately before carrying out a task
Permit to Work (PTW)	A safety management documented system adopted by most organizations for management of work activities
Regime	The collective noun for Maintenance Plan applied to an asset, system, facility, or building
Run to Failure (RTF)	A maintenance strategy where the asset is deliberately not maintained but allowed to run until it fails
Sequence of Operation (SOO)	A written explanation and description of the MEP systems on how the systems are intended to work
Test	Confirming by means of observation or measurement that the system meets the expected and/or acceptable requirements
Threshold	Numerical value of a parameter at which a decision is made
Abbreviations	
AMS	Asset Management System
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BACNet	Building Automation and Control networks
CPU	Central Processing Unit
DARS	Digital Audio Radio Service
DI	Digital Input

Term	Definition
DO	Digital Output
EVC	Extra Low Voltage
FDD	Fault Detection and Diagnostics
FM	Facilities Management
FOC	Facilities Operating Company
GUI	Graphical User Interface
HMI	Human Machine Interface
HSSE	Health, Safety, Security, and Environment
HTM	Healthcare Technical Memorandum
I/O	Input/output
IT	Information Technology
JHA	Job Hazard Analysis (see Point of Work Risk Assessment (POWRA))
KPI	Key Performance Indicator
LEED	Leadership in Energy and Environmental Design
LV	Low Voltage
MEP	Mechanical, Electrical, and Plumbing
NAE	Network Automation Engine
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
PAR	Periodic Automatic Replenishment
PAT	Portable Appliance Test
PC	Personal Computer
PM	Planned Maintenance
PPE	Personal Protective Equipment
PM	Planned Maintenance
PTW	Permit to Work
RAMS	Risk Assessment and Method Statement
RTF	Run to Failure
SC	Statutory Compliance
SOO	Sequence of Operation
UPS	Uninterruptible Power Supply
VDU	Visual Display Unit

Table 3

4.0 REFERENCES

- American National Standards Institute (ANSI)
- British Standard Institute (BSI) – BS 5839
- Chartered Institution of Building Service Engineers (CIBSE) – Guide M
- EOM-ZW0-GL-000002 - Maintenance Procedure Writers Guide
- Healthcare Technical Memorandum (HTM) – HTM 05-03/08-3
- International Electrotechnical Commission (IEC) – IEC 60870
- ISO 55000
- ISO 9001: Quality Management Systems
- National Institute of Standards and Technology (NIST)
- National Manual of Assets and Facilities Management - Volume 10: Health, Safety, Security, and Environment (HSSE)
- National Manual of Assets and Facilities Management - Volume 11 Chapter 5: Quality Control Procedures

- National Manual of Assets and Facilities Management - Volume 12: Risk Management
- National Manual of Assets and Facilities Management - Volume 6 Chapter 9: Electrical Systems Maintenance Plan for Healthcare - EOM-ZM0-PL-000025
- National Manual of Assets and Facilities Management - Volume 6 Chapter 8: Mechanical Systems Maintenance Plan for Healthcare - EOM-ZM0-PL-000019
- National Manual of Assets and Facilities Management - Volume 6 Chapter 12: Life Safety Systems Maintenance Plan for Healthcare - EOM-ZM0-PL-000043
- National Manual of Assets and Facilities Management - Volume 6 Chapter 11: Security Systems Maintenance Plan for Healthcare - EOM-ZM0-PL-000037
- National Manual of Assets and Facilities Management - Volume 6 Chapter 17: Escalators & Lifts Maintenance Plan for Healthcare - EOM-ZM0-PL-000061
- National Manual of Assets and Facilities Management - Volume 6 Chapter 3: Preventive and Predictive Maintenance Program Procedure - EOM-ZM0-PR-000003
- National Manual of Assets and Facilities Management - Volume 6 Chapter 3: Description and Definitions - EOM-ZM0-PR-000002
- National Manual of Assets and Facilities Management - Volume 8: Supply Chain Management
- National Manual of Assets and Facilities Management Volume 4 Chapter 2: Obsolescence Management - EOM-ZL0-PR-000003
- NFPA 297 (National Fire Protection Association) – Communication Systems
- Occupational Safety and Health Administration (OSHA) - Occupational Safety and Health
- SFG 20 (Services and Facilities Group within Building Engineering Services Association)
- Volume 3 Chapter 3: Conducting Condition Assessments - EOM-ZC0-PR-000004

5.0 RESPONSIBILITIES

Only trained and competent persons shall be appointed by management to perform maintenance tasks on Communication systems.

Role	Description
Communication System Operator	An authorized individual who operates the Communication system
Competent Person – Communications Engineer	An individual who is of the opinion of an Authorized Person and competent to work on communication systems
Designated Person (communication systems)	An individual who has overall authority and responsibility for the premises containing the communication system within healthcare and has a duty to prepare and issue a general policy statement on Healthcare in relation to Communication systems
Duty Holder	An individual who is responsible for the Operations and Maintenance (O&M) of the communication systems within the organization
Operations and Maintenance (O&M) Person (communication systems)	A person of the engineering staff, communication, manufacturer, or O&M organization, employed by management to carry out duties on Communication assets

Table 4

Roles & Responsibilities for PM Scheduling and Implementation

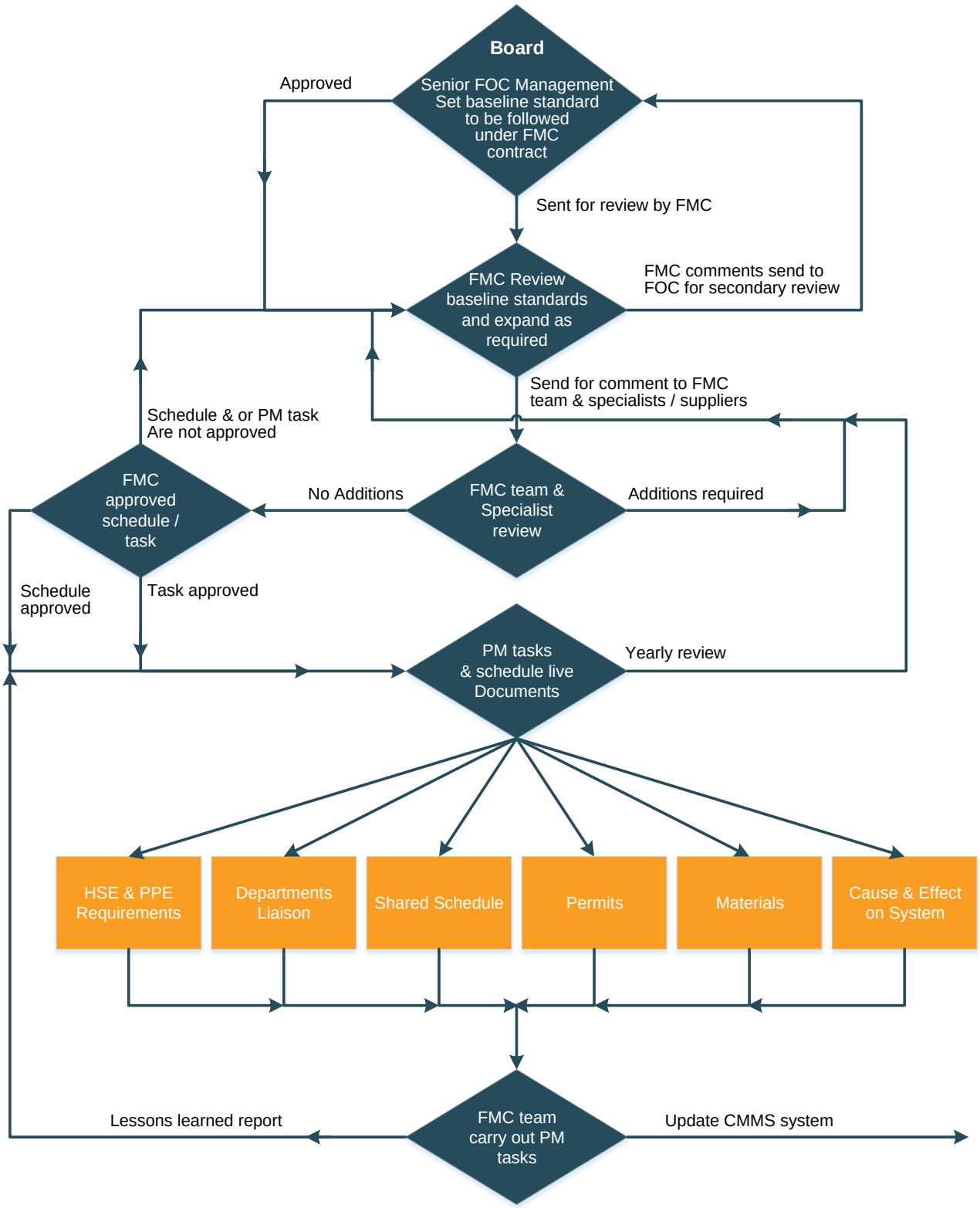

Figure 1: PM scheduling and implementation

6.0 PROCESS

6.1 Communication Systems Introduction

Communication Systems are a key strategic technological capability for the delivery of key priorities over the next 10 to 15 years: reliability and safety, current capacity, and future demand on Healthcare services, which is expected to grow significantly. New technologies are challenging the existing principles of how we communicate to operate and maintain the Health Care services.

The primary purpose of Communication Systems is to provide effective, secure, and resilient audio, visual, and data systems that support the O&M of the Healthcare Entity. Reliable communications systems are, therefore, critical to the effective and safe operation of Health care services. The systems must deliver the right information to the right people, machines, and places at the right time in order for the best decisions or actions to be taken. A communication system is a number of elements or parts together; the overall system is considered fit for purpose when all elements and parts collectively are working as expected.

There is a possibility that all elements collectively may not result in “fit for purpose” and deliver a poor performance. This is where the planned maintenance regime of those elements and system as a whole is absolutely crucial to critical services. This helps maintain department critical services to a high readiness and reduce downtime which could otherwise affect patient welfare and facility operations.

New communication systems will also offer opportunities in other areas such as flexible Health care functions and operations, reduced asset base, and lower operating cost. Consequently, a whole system approach will be the best way to deploy solutions for these issues and for related technological developments.

In Healthcare services, there are many health individuals wishing to share patient information via various communication protocols, which, as a result, has increased the need for IT to support health services. IT data networks are not covered within this document; external resources should be consulted for these areas, especially, with respect to data confidentiality.

6.1.1 Strategic Approach

Secure and effective communication systems and data are required to provide effective service across Health care as well as to support the backbone shared with emergency services. The need for more flexible use of Health care staff requires communication systems to have the flexibility and expansion capability to cost-effectively cater to new and changing business requirements. Consequentially, existing systems that no longer meet the performance requirements or are operationally obsolete will be removed. Consideration should also be given to the removal of obsolete data cabling in risers and trunking to free space for alternative systems, without the need for expensive infrastructure to be installed.

6.1.2 Advantages of Effective Communication Systems

- Improvement of staff and inter-departmental communication
- Reduction of decision-making time during incidents to ensure a swift return to normal service
- Removal of the need for local viewing and decision making
- Patients being provided with quality information
- Improved real-time information that enables staff to make effective decisions
- Flexible use of Communication systems to ensure incidents are notified as quickly as possible

6.2 Communication Systems Maintenance Strategy

Maintenance is a combination of all technical, administrative, and managerial actions during the lifecycle of a device. A maintenance strategy is intended to retain or restore a device or piece of equipment to a new or as new condition in which it can perform the required function. Communication systems maintenance shall cover tests, measurements, replacements, adjustments, and repairs intended to retain or restore a unit or equipment to a state where equipment or asset can perform its function. It is essential to keep and preserve equipment and the facility in a good functional state. Maintenance of systems should only be undertaken by personnel who are trained and competent in the equipment under maintenance. Failure to adhere to this can lead to extended downtime and expensive repair costs due to Urgent attendances of 3rd party specialists.

Below, Figure 2 shows the various types of maintenance activities involved in order to maintain a reliable communication system.

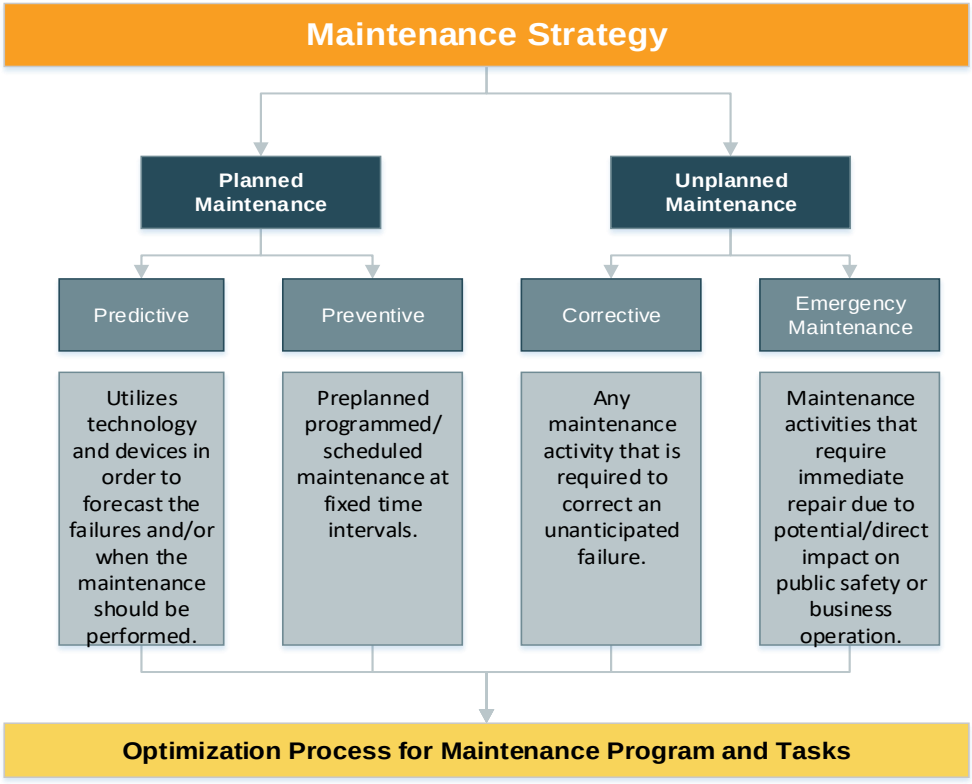

Figure 2: Relationship of Maintenance Concepts and Activities

6.3 Types of Maintenance

Depending on the Entity's asset management strategy, organizational maturity, and funding, the following types of maintenance may be applied to HVAC 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).

This document focuses primarily on PM.

6.3.1 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.

Key elements and advantages of scheduling and executing PM are

- Care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for the systematic inspection, detection, and correction of incipient failures, either before they occur or before they develop into major defects
- Maintenance including tests, measurements, adjustments, and parts replacement, performed specifically to prevent faults from occurring
- Elimination or mitigation of the consequences of failure of equipment
- Prevention of failure (Planned maintenance and condition-based maintenance)
- Preservation and restoration of equipment reliability by replacing worn components before they actually fail
- Planned maintenance tasks including partial or complete changes, upgrades or partial major components replacement, and minor or major adjustments

6.3.1.1 Statutory Requirements

It is incumbent that communication assets and system maintenance shall be performed on system/assets that require regular maintenance/inspections at set intervals as specified by Original Equipment Manufacturers' (OEMs') recommendations, and Statutory Compliance (SC) requirements. There are a number of communication assets and systems that require statutory maintenance and inspections. Those assets are normally associated with life safety and security, such as PAVA and Fire detection systems. Below are the Expro's documents related to statutory obligations:

1. Electrical – EOM-ZM0-PL-000025
2. Mechanical – EOM-ZM0-PL-000019
3. Life Safety – EOM-ZM0-PL-000043
4. Security – EOM-ZM0-PL-000037
5. Lifts – EOM-ZM0-PL-000061

1. The Entity shall ensure that those assets are identified and plan and schedule the maintenance activities as and when required. In addition to the required maintenance being planned, it is also crucial that the contractors and persons carrying out the tasks are competent to do so. See attachment 1, Communication Planned Maintenance Schedule.

Planned Maintenance Procedures are provided within Volume 6, Chapter 3 of the NMA&FM - EOM-ZM0-PR-000003.

6.4 Maintenance Planning and Scheduling

Planning decides what, how, and the time estimate for maintenance tasks. Schedules decide when and who will perform the maintenance tasks. Proper planning is a vital part in successfully managing the maintenance of equipment. Planners must collaborate with internal or external stakeholders to achieve optimum results. A comprehensive maintenance schedule shall be developed and equipment or assets should be listed in the maintenance schedule. When putting communication system maintenance schedule together, all maintenance activities, along with other department's recommendations, personal experiences, equipment history, and OEM recommendations shall be considered. Moreover, the schedule shall define clearly the types of maintenance activities, in particular, corrective maintenance, preventive maintenance, predictive maintenance, 'run to fail' checks, and planned shutdowns.

The below elements shall be taken into consideration when planning and scheduling communication assets and systems maintenance tasks.

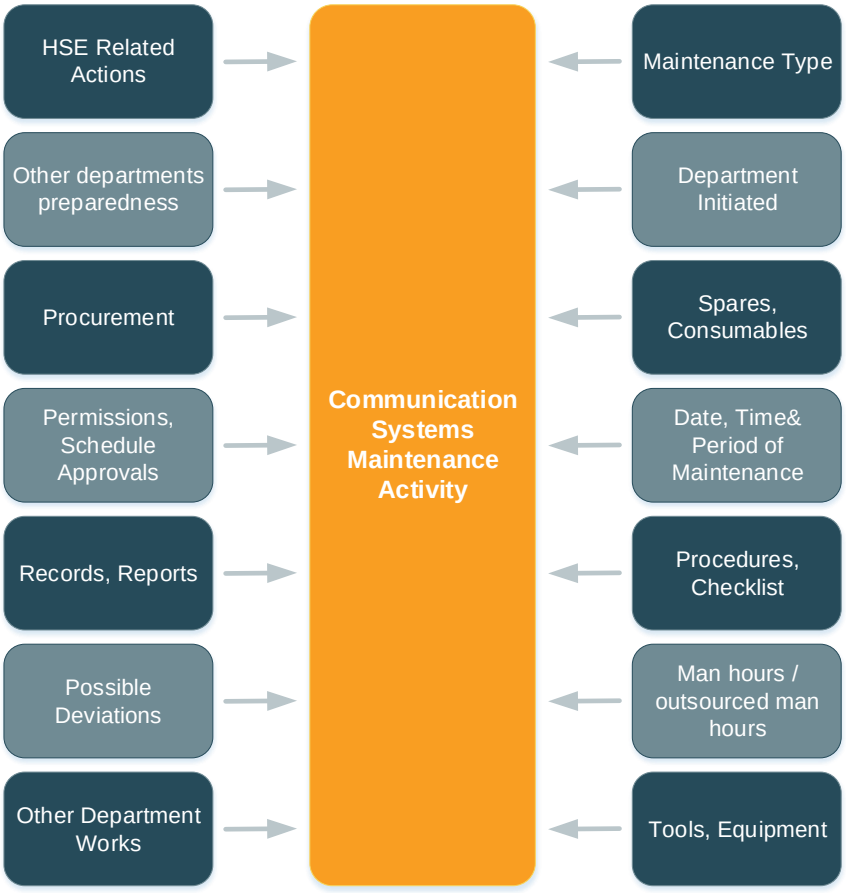

Figure 3: Pictorial Representation of Links of Maintenance Activity

6.5 Asset Management System (AMS) Requirements

- Communication system maintenance plans shall include a list of tasks and likely/recommended/compliant frequencies
- Communication system plans may refer to an industry resource with specific or likely tasks numbers or state other guidelines
- Communication system plans should recommend the storage method for recorded values ('data points'), for example, within the AMS or other approved centralized recording and analysis medium,

when trend analysis or threshold values are applicable. Additional parameters check points record sheets shall be attached to work orders to validate the results during testing and maintenance
- Communication system plans should identify potential opportunities for updates to maintenance activities that provide cost savings and efficiency. For further details on AMS standards, refer to AMS standards document number ENT-ZAO-SD-000001

6.6 Health and Safety

There are always risks associated with any working environment. The maintenance tasks involve risks during working alongside equipment, a running system, or close contact with live communication system devices. There could be likelihood or possibility of human error that can lead to accidents and systems malfunction. During maintenance activities, direct contact between maintenance staff cannot be reduced substantially due to the involvement of unusual work, non-routine maintenance tasks, and often exceptional working conditions such as confined spaces.

Working under time pressure is also substantial in maintenance, especially when shutdowns or high-priority maintenance works are involved. Henceforth, attention to the management of risks associated with maintenance works shall be assessed fully in order to prevent harm. Therefore, supervision of staff should be employed when maintenance activities are under way to ensure that correct and safe procedures are being adhered to. In addition, any defects that may affect completion and reinstatement are identified and notified to stakeholders.

Below elements shall be considered while assessing risks involved with communication systems maintenance:

- Identify the hazards involved during maintenance activity
    - Risk to the other operational healthcare utilities during working on communication systems or any associated system
    - Risk to the philosophy of design and cause and effect programs
    - Risk to data loss
    - Risk to Communication systems software, configurations, and applications
    - Risk to equipment
    - Reputational risk to the Entity for loss of service/availability
    - Others
- Establish stakeholders that can potentially be harmed and highlight greater risks involved
- Evaluate the risks involved, and eliminate or mitigate to ensure safe work is completed
- Involve maintenance team, specialist engineers, and HSSE team in risk assessment process
- Take action – Decide on measures needed, a plan, how to implement the plan, and who does what and when
- Monitor and review the process
- Record the findings

Maintenance team or their representatives shall be involved in the process. There shall be a comprehensive Risk Assessment and Method Statement (RAMS) available during maintenance tasks on communication systems. A JHA (Job Hazard Analysis) must be conducted as well for the Visitors, contractors, and others working under site-specific Health and Safety plans.

Reference: Volume 10: HSSE and Volume 12: Risk Management

6.6.1 Risk Management

Risk Management is about identifying undesirable occurrences that could have an impact on Communication systems and associated equipment. Therefore, gaps shall be assessed to avoid such negative hazards and risks.

Below are some risks that shall be in place, but not limited to

- Fire hazard to electrical systems
- Excessive heat in electrical and utility services rooms

- Overloads on equipment
- Non-accessible devices, assets, and panels
- Others

The maintenance team shall complete a comprehensive set of RAMS covering each mechanical system within the housing facility. For task-specific activities, a 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 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 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
- Identify competency requirements for personnel undertaking maintenance activities
- Quantitatively evaluate risks using a risk matrix (involve maintenance team, subject matter experts, and HSSE team in risk assessment process and hold a Risk Workshop as necessary)
- Take action – decide on mitigation measures needed, required investment, responsibilities and timeline
- Review the risk evaluation following implementation of mitigation measure
- Record findings and implement improvements following experience

Reference: Volume 10: HSSE and Volume 12: Risk Management

6.6.2 Quality Control and Quality Assurance

The Facilities Operating Company (FOC) shall ensure that all maintenance tasks are performed in order to reduce any potential risks to equipment failure. In order to maintain quality of the maintenance tasks, FOC shall adhere to the following:

- A stringent Permit to Work (PTW) shall be followed for the maintenance tasks
- All maintenance activities shall be performed as per manufacturer manual and recommendations
- PM frequencies shall be followed as per manufacturer guidelines
- All maintenance records shall be recorded manually or through Computerized Maintenance Management System (CMMS) or AMS (if available); both hard copies and soft copies shall be maintained for references

QC represents the quality standards which shall be met by each Entity. However, QA is the method by which it is checked that quality standards are met and opportunities for continuous improvement are captured.

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 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
- PTW which ensures a safe system of work to protect people from the system, but also limits human error by removing single point of failure through involvement of Authorized Persons

Further information can be obtained within ISO 9001: Quality Management Systems.

Reference: Volume 11 Chapter 5: Quality Control

6.6.3 Spares/Consumables/Inventory

Unlike buildings, communication systems technology can quickly become unusable. This is primarily due to the short lives, rapid obsolescence, and the critical need to stay up-to-date with technologies that may not be supported by vendors in the future and render the technology unusable.

A standard practice shall be in place to refer to the Bill of Material (BOM) for the communication systems and associated equipment including a spare/consumable tracker list. Clear description of part number, make, model, and quantity shall ideally be a part of AMS information to retrieve material details whenever required. However, in case of unavailability of AMS, a soft copy of all material installed along with necessary details shall be available with facilities team, which shall determine Periodic Automatic Replenishment (PAR) levels. The Entities shall refer to EOM-ZL0-PR-000003 in relation to Obsolescence Management.

Inventory control process shall define critical items, non-critical items, and below elements shall be considered while developing the inventory details:

- High cost spares/consumables
- Long lead items
- Items obsolete in market
    - Replacement of the communication systems components which are no longer in production by the original manufacturer according to the original specification shall be assessed carefully without compromising quality, efficiency, and Process and Instrument Design (P&ID) functions in a healthcare facility

Reference: Volume 4 Chapter 2: Obsolescence Management - EOM-ZL0-PR-000003

- High use/low use items
- Alternate material selection options
- Technical Specifications
- Others

Parts/consumables with high failure rate shall be highlighted during maintenance activity and further failure analysis shall be performed to identify root cause analysis of the components failure. These components shall run up to their designed life in order to optimize costs.

Maintenance schedules may require to be altered to prevent unwanted breakdown and further design analysis should be considered following results of RCA techniques.

Reference: Volume 8: Supply Chain Management

6.6.4 Communication Assets and Systems Maintenance Methodology

6.6.4.1 Communication Systems Maintenance

Communication systems and assets maintenance shall cover all communication systems used in Health care to ensure communication assets and systems are well maintained and in good working condition.

To ensure communication assets and systems perform efficiently and effectively, the systems shall have a periodic maintenance schedule in place by facilities O&M parties and shall fully comply to statutory requirements, local regulation, and OEM guidelines. This schedule shall cover routine checks and PM frequencies.

Communication systems maintenance consists primarily of inspection, testing, adjustments, calibrations, and replacing minor components parts.

The timely completion of planned maintenance tasks without compromising quality of the work will increase equipment reliability and service life. Depending on the safety implications inherent in potential malfunction

or breakdown and/or the cost of the equipment replacement, planned maintenance tasks shall be typically scheduled at a prescribed frequency by the manufacturer or statutory requirement in healthcare facility. In case there are no defined guidelines set by manufacturer, maintenance schedule shall cover weekly, monthly, quarterly, biannual, or annual maintenance as a minimum in consideration of criticality assessment of the communication assets and systems.

The testing and maintenance guidelines mentioned below shall be followed as a minimum to operate and maintain the integrity of the system on the Basis of Design (BOD) and Sequence of Operations (SOO). Communication assets and systems maintenance schedules shall cover the integrity test and functionality check of devices, assets, application software, and associated hardware.

As a minimum, the below recommended inspections and planned maintenance shall be performed at local site levels:

- Check and confirm each Input/output (I/O) points for proper terminations from end to end during planned maintenance activity
- Check panels are free from dust and debris
- Check for connectivity and cabling integrity
- Check sensors for expected operation
- Check route, ducting, equipment, housings, and conductor conditions
- Check whether communication operation at nodes and end services confirms operating parameters
- Perform equipment and system checks as recommended by OEMs
- Check for Human Machine Interface (HMI) required functionality
- Check whether Personal Computer (PC) software is loaded and functioning correctly
- Check for cooling in communication rooms
- Check for cabling appropriately routed and protected
- Check servers and fire wall
- Conduct Cyber and Data security checks
- Verify controller's network communication
- Check and verify the reliability and functionality of all communication systems workstations graphics and applications
- During maintenance, check and verify to ensure communication system PC is free from unwanted programs and temporary files
- Fill all gathered results and data in PM sheets for references and use at a later date

6.6.4.2 Condition Assessments (CA)

In order to ensure that the assets are in good condition, The Entity shall make planned provisions to carry out CA as per Expro's standards contained in Volume 3 Chapter 3: Conducting Condition Assessments - EOM-ZC0-PR-000004. The CA shall confirm the condition of the assets, as indicated below. The items include, but are not limited to

- Antennas and antenna bracing – confirm the condition of antennas and their bracing/supports
- Low-voltage systems (Internet and telephone connections/cables) – confirm that cables are properly connected in strategic areas to avoid system overload
- Alternative communications systems – confirm the condition of other communications systems, namely radio communications, satellite telephone, and Internet
- Anchors and braces for telecommunications equipment and cables – confirm that telecommunications equipment (DARS and satellite telephone system) is anchored for increased security
- External telecommunications systems installed on hospital grounds – confirm that external telecommunications systems infrastructure does not interfere with communications of the hospital telecommunications systems
- Sites and communications rooms – confirm they are in adequate conditions and well cooled
- Internal communications systems – confirm the condition of public address system and speaker systems

6.6.4.3 Pre-Requisites of the Maintenance

Before maintenance activities are carried out, it is vital for The Entity to ensure that all shake-holders are informed and engaged at an early and appropriate stage prior to any maintenance activities.

The maintenance team or contractor shall ensure that all planned work has been reviewed, approved, and has been given permission by the Entity prior to any maintenance activities.

The Entity shall notify all stakeholders of any planned work and advise them of any potential impact, if any, to their operations. In addition, The Entity shall ensure that adequate contingency planning are in place prior to maintenance and this has to be reviewed and approved by The Entity.

- Tools/Specialized Tool Kits/Personal Protective Equipment (PPE)
  - All software, databases, configuration tools, and analysis tools shall be used as needed during inspection and performance testing
  - Measurement and calibration tools shall be Portable Appliance Test (PAT) tested and certified through the National Institute of Standards and Technology (NIST) or similar

- RAMS
  - Risk Assessment and a comprehensive Method Statements shall be in use as a safe practice of work. All results identified from risk assessments shall be documented and referred back to a method statement for the completion of maintenance tasks
  - A person performing maintenance activities shall be deemed competent to carry out maintenance tasks on communication assets and systems
  - An engineer/technician shall have recognized qualifications relevant to communication assets and systems
  - An engineer/technician shall have sufficient training and experience in communication assets and systems or the electrical engineering field
  - A JHA shall be completed by personnel carrying out the required maintenance

- PTW
  - Switching off any fuse, power circuits, breakers, distribution boards, or mains circuit boards that may affect any of the equipment associated to communication assets and systems controllers and server shall be subject to PTW authorized by an engineer or manager of the facility
  - All PTW shall include an approved RAMS to perform the maintenance tasks

- Drawings/Schematics
  - The drawings/schematics shall be included and referenced along with a PTW to identify the point of maintenance activities and consequences at a planning stage
  - Drawings/documentation shall be updated following upgrades/enhancements/modifications

- SOO
  - Maintenance task shall include SOO so that process and system cause and effect shall be clear to and understood by all parties involved in the maintenance task to be completed
  - The maintenance activity shall be reviewed and adapted following lessons learned

- Redundancy Planning
  - Healthcare facilities mostly cover critical equipment and systems, and therefore, it is essential to keep backup or standby equipment ready whenever needed. While planning maintenance, a substantial level of planning shall be performed and redundant equipment or system to be used during emergencies shall be considered
  - Communication assets and systems equipment such as, but not limited to, supervisory control PC, communication controllers, main server, temporary server, and other essential equipment shall be available to manage communication assets and systems functions during any emergency into operations, any component failure, or during any planned maintenance activity. Cause and effect shall be referenced during all scenarios and contingency plan shall be in place

- Documentation
    - Documentation is an essential element of maintenance tasks. Facilities operations team shall ensure that relevant documentation of the pre-maintenance tasks and post-maintenance tasks is available with facilities technicians, Supervisors, and Engineers to track maintenance logs/records. The below documents shall be available within facilities team, but are not limited to:
        - Written maintenance procedures and RAMS
        - SOO
        - PTW
        - Drawings/Schematics
        - Task sheets
        - Work orders to record non-conformities
        - Others site-specific

6.6.4.4 Communication Systems and Other Associated Systems

The communication assets and systems maintenance fundamentals mentioned below shall be covered while developing task sheets and maintenance schedule for communication assets and systems, but are not limited to:

- Control strategy or application software functionality check
- Communication assets and systems functionality check
- Set Points check – All set points shall be checked to ensure realistic values, thresholds, and operating ranges
- Time control check – All time routines shall be checked
- Interlocks check – All interlocks shall be checked
- Digital Input (DI)/Digital Output (DO) ranges check for voltage and current according to OEM standard and on the BOD parameters
- Digital/Analog inputs on field devices such as sensors
- Cause and effect check according to the BOD
- Monitoring status of sensors and devices
- Field wiring connections, interlock connections, and hard wire connection checks
- Software points check
- Alarm Functions check
    - The operation of each alarm function shall be checked
    - Time delay on each alarm function shall be checked
    - Level of category of alarm, its destination, and reporting method shall be checked
    - Operation of alarm masking shall be checked
- Graphical User Interface(GUI)/Supervisory/Field Inspection and Check Points
    - Cyber security taken into consideration
    - Application/Software check/Firmware updates
        - Status (ON/OFF) and Commands status
        - Alarms, trends, and communication
        - Passing Bus Address
        - Thermostats functionality and calibration
        - Temperature set points
        - Local controller operation
    - Fault status
    - Device counts/Overload
    - Online/Offline status
    - NAE (Network Automation Engine) object counts
    - Central Processing Units (CPU) temperatures
    - Board temperature

6.6.4.5 Access to Infrastructure Assets/Communication Rooms

All assets shall be protected from unauthorized entry. It is the responsibility of The Entity to ensure that all assets are protected and secured from unauthorized entry. The Entity shall ensure that processes and

systems are in place for surveillance and for entering communication rooms and other communication associated assets.

Personnel attending the facility should be vetted to ensure that they are familiar with any site restriction and special policies. They should be registered with site security so that untrained personnel do not access vulnerable areas. All contractors are to report to site security upon arrival at site.

Communication rooms and risers should be locked at all times and where Access control is applied, regular reviews should be undertaken to ensure staff access is still warranted. Removal of access is to be done on personnel terminations through discipline or leavers.

7.0 ATTACHMENTS

1. Attachment 1 – EOM-ZM0-TP-000177 - Communication Planned Maintenance Schedule Checklist – Healthcare

Attachment 1 – EOM-ZM0-TP-000177 - Communication Planned Maintenance Schedule Checklist - Healthcare

The below schedule is a sample of planned maintenance activities, however, The Entity shall proactively source from the manufacturer, the required maintenance for each assets.

Building Name:			**Reference No.**		**Rev-00A**		
Functional Critical Planned Maintenance Communication System							
Sr. No.	**Item**	**Frequency (FQ)**	**Action**	**Notes**	**CHECKED SATISFACTORY**		
					N/A	**Yes**	**No**
1.1	Diagnostic Routine on Computer (where appropriate)	Biannual	Perform diagnostic tasks and check computer operation	This routine will check all aspects of computer hardware and software	☐	☐	☐
1.2	Wireless Systems	6 Monthly	Clean and examine bells, buzzers, pull cords, pushes, indicators, relays, contact boxes fuses. Ensure terminal connections are sound	Visually inspect printed circuit boards. Clean, examine, and test all components of the system and reset as required. Examine antennae	☐	☐	☐
1.3	System Checks	6 Monthly	Clean, examine and test all components of the system and reset as required. Examine antennae		☐	☐	☐
1.4	Batteries	6 Monthly	Test dry batteries, renew as necessary, and ensure their security		☐	☐	☐
1.5	Filters	Biannual	Check condition, clean and lubricate, if necessary		☐	☐	☐
1.6	Software Archives	Biannual	Take back-up copy of site-specific data files. Confirm operating programs and functionality	Ensure that security is retained and that any updating of files is incorporated. It is recommended that a copy of the back-up data is stored in a fireproof safe or off-site	☐	☐	☐
1.7	Cables	Annual	Check security, integrity, and for physical damage		☐	☐	☐
1.8	Discs and Drives	Annual	Clean according to the manufacturer's instructions		☐	☐	☐
1.9	Clock Battery	Annual	Check and replace, if necessary	Battery disposal should be in accordance with regulation and environmental requirements	☐	☐	☐
1.10	Connectors	Annual	Check connectors for security and integrity		☐	☐	☐
1.11	Mouse	Annual	Check for smooth operation and clean ball as necessary	More frequent cleaning can be implemented, if needed	☐	☐	☐
1.12	Visual Display Unit (VDU)/Monitors	Annual	Check: • Focus • Contrast • Brightness • For correct operation		☐	☐	☐
1.13	Keyboard	Annual	Check for correct operation and clean		☐	☐	☐
1.14	Cables and Connectors	Annual	Check security, integrity, and for physical damage		☐	☐	☐
1.15	Cleaning	Annual	Use recommended cleaning agent	Remove paper or tape debris	☐	☐	☐

Building Name:	Reference No.	Rev-00A

Functional Critical Planned Maintenance Communication System

Sr. No.	Item	Frequency (FQ)	Action	Notes	CHECKED SATISFACTORY		
					N/A	Yes	No
1.16	Data Communications	Annual	Check integrity of data flow in both directions	If more than one path exists, all must be verified	☐	☐	☐
1.17	Closed Circuit Television (CCTV) System check	Twice Annually	Check systems for functionality and operability		☐	☐	☐
1.18	Connectors	Annual	Check security, integrity, and for damage		☐	☐	☐
1.19	Remote Video Response Centre	Twice Annually	Checks to confirm remote operation		☐	☐	☐
1.20	Lift Auto Dialer	Every three days checks	Input signal of alarm checks		☐	☐	☐
1.21	Alarms Receiving	Annual	Confirm that all critical alarms are received by the central supervisor. Check spurious alarms and report faults (as incurred)		☐	☐	☐
1.22	Alarms Generating	Annual	Check generation of alarms from all input and output devices		☐	☐	☐
1.23	Network	Annual	Check communications between central supervisory computer and outstations, and other networked devices		☐	☐	☐
1.24	Outstation Hardware	Annual	Check mechanical and environmental condition	Environmental conditions, such as temperature and humidity should be within the manufacturer's recommended limits	☐	☐	☐
1.25	Connectors	Annual	Check security, integrity, and for damage	Includes security of incoming cables, prevention of ingress of moisture, door seals	☐	☐	☐
1.26	Digital Inputs (DIs)	Annual	Check by activating sensing/control devices in field	Care shall be taken to isolate local operation	☐	☐	☐
1.27	Digital Outputs (Dos)	Annual	Check operation of output stopping by operating routine (where appropriate). Check switching by software interlocks		☐	☐	☐
1.28	Vented Batteries	Quarterly	Vented batteries should be examined to ensure that the specific gravity of each cell is correct	Electrolyte levels should be checked and topped up as necessary, and the specific gravity of the electrolyte in each cell should be checked to ensure that it is correct	☐	☐	☐
1.29	User Checks – Outstation	Weekly	An outstation should be operated	It should be confirmed that the call is correctly received at the master station	☐	☐	☐
1.30	User Checks – Master Station	Weekly	In premises in which the location of the master station is such that the audible fault warning signal could go unnoticed for longer than 24 hours	A special check should be carried out each day to confirm that either the equipment indicates normal operations or that any fault indication is receiving necessary attention	☐	☐	☐
1.31	Analogue Inputs	Annual	Read and check calibration of analogue inputs		☐	☐	☐

Building Name:	Reference No.	Rev-00A

Functional Critical Planned Maintenance Communication System

Sr. No.	Item	Frequency (FQ)	Action	Notes	CHECKED SATISFACTORY		
					N/A	Yes	No
1.32	Analogue Outputs	Annual	Check for accuracy of output signal		☐	☐	☐
1.33	Installed Program	Annual	Check integrity, alarms, interlocks, and optimization		☐	☐	☐
1.34	Time Clock	Annual	Check real time clock and date for accuracy throughout system		☐	☐	☐
1.35	Time Switching	Annual	Review current operating parameters according to site needs	For example, Time settings and schedules	☐	☐	☐
1.36	Data Logging	Annual	Review the need for existing data logs. Delete/archive logs as required	Report to Management on the need to review existing arrangements	☐	☐	☐
1.37	Alarm Management and Report	Annual	Review frequencies of generated alarms. Review alarm log records for indication of untoward conditions	Report and record if any non-conformance, as appropriate	☐	☐	☐
1.38	Software Interlocks	Annual	Check and confirm operation	Report and record if any non-conformance, as appropriate	☐	☐	☐
1.39	Electrical Test on Communication Systems	3 Yearly	Carry out a periodic inspection with associated circuit tests in accordance with BS7671		☐	☐	☐
1.40	Communication Rooms and Server Rooms CO_2 and Inert Gas Systems	6 Monthly	Panel Test, Inspect, and Test and Enclosure integrity		☐	☐	☐
1.41	CCTV	Annually	Inspection and testing of all associated equipment	Full inspection and testing. Written records including date of test, next test date, defects found, and record of repairs	☐	☐	☐
1.42	Testing of Sounders and Call Points		Activation of manual call point to confirm system operations of the indicative equipment		☐	☐	☐
1.43	Security/Access Systems	Annually	Carry out a full test, inspection, service, and maintenance of system		☐	☐	☐
2.0	Specific Planned Maintenance (PM) Notes				☐	☐	☐

No.	Reviewer's Comments	Resolution
	Originator's Name/Signature and Date:	Checker's Name/Signature and Date:

Table 5