

National Manual of Assets and Facilities Management

Volume 5, Chapter 4

HVAC Systems Operations – Healthcare Procedure

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HVAC Systems Operations – Healthcare Procedure

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1.0 PURPOSE

Heating Ventilation & Air Conditioning (HVAC) is used extensively in all types of healthcare premises to provide a safe and comfortable environment for occupants. The aim of air conditioning is to control the thermal environment, largely through simple adjustments to air temperatures. The method by which air temperature is adjusted, and the effect that this has on overall comfort control, will depend on the form of air conditioning employed and its ability to provide a uniform thermal environment.

The introduction to HVAC systems provides a generic overview of the types of systems that are likely to be found within a healthcare facility, but is not as comprehensive, as the requirements of each facility will differ according to its particular function.

The Operations Management for HVAC systems document has been compiled utilizing the latest references available for the inclusion within the manual but may be subject to change throughout the lifetime of the Assets and Facilities Management Manual.

The purpose of this document is to provide the Entity in the Kingdom of Saudi Arabia (KSA) the procedural guidelines for Operations Management of HVAC systems for healthcare following The Royal Decree passed by the Saudi Council of Ministers mandates the use of HVAC for healthcare necessitating their facilities to be safe, efficient, and compliant. These guidelines contain operations expectations consistent with the Expro approach, using best practices developed through industry experience.

The intention is to provide adequate reference and methodology to Entities, facilities managers/service providers for creation of their own documents and processes and act as an aid for engaging with external parties for the delivery of service.

References have been provided within the document to direct users to the 'specific' requirements of any decree or regulation as a point of reference. Where only a summary is provided within the guidelines, the actual reference should always be the standard that shall be employed.

2.0 SCOPE

The operations management guidelines establish the uniform operational criteria and standards for HVAC systems and equipment to enable quality and cost-effective facilities maintenance that meets the needs and expectations of the Entity.

The Entity will need specific operational procedures for healthcare by which the conditions may dictate the need to exceed the minimum requirements stated within these guidelines.

The provision of these guidelines is not intended to prohibit the use of alternative systems and methods, not specifically described. However, the use of alternative systems and methods can only be considered after receiving approval from the Entity.

This chapter should contribute to a healthcare operational policy that may cover various aspects of HVAC systems. Staff responsible for the safe use of a HVAC system should receive specific training before being permitted to handle a system or associated equipment. This document shall outline the key personnel involved in the operation and general use of the system.

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 operations management requirements provided herein, or cited by reference, are based on International Standards Organization (ISO), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), Health Technical Memorandum (HTM) and Chartered Institution of Building Services Engineers (CIBSE) industry standards and best practices that should be observed by the



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appropriate Entity. This may be subject to change throughout the lifetime of the National Manual of Assets and Facilities Management (NMA & FM).

This document provides the minimum technical requirements to be adopted by the Entity and/or contractors to enable safety, quality, and cost effectiveness in the operations of new and existing HVAC systems that meet the needs and expectations of the relevant Entity.

Using this document, the Entity shall establish and develop set procedures ensuring the continuous operation of HVAC systems for new and existing healthcare facilities. This may dictate the need to exceed the minimum requirements outlined within these guidelines

3.0 DEFINITIONS

A universal list of terms and their associated definitions as they apply to the Entity, are outlined in Volume 6, Chapter 3.1 of the National Manual of Assets and Facilities Management – Descriptions and Definitions (CKD-KE0-GL-000011). Definitions specific to this particular section of the National Manual of Assets and Facilities Management, are listed below:

Term	Definitions
Atmosphere	The gaseous envelope surrounding the earth (outside conditions)
Concealed Exterior	Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures
Concealed Interior	Concealed from view and protected from physical contact by building occupants
Conditioned	Spaces directly provided with heating and cooling
Energy Utilization Index	The measure of the total energy consumed by a building expressed as energy consumed per gross building area (kJ/M2)
Exposed Interior	Exposed to view indoors (not concealed)
Exposed, Exterior	Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions
Finished Space	Space other than mechanical rooms, electrical rooms, furred spaces, pipe chases, unheated spaces immediately below roof, space above ceilings, unexcavated spaces, crawl spaces, tunnels, and interstitial spaces
Indoors	Located inside the exterior walls and roof of the building
Outdoors	Located outside the exterior walls and roof of the building
Second Party	Facilities Service Provider FM
Acronyms	
ACH	Air Change per Hour
ACOP	Approved Code Of Practice
AE(V)	Authorized Engineer (Ventilation)
AHJ	Authority Having Jurisdiction
AHU	Air Handling Units
AMS	Asset Management System
ANSI	American National Standards Institute
AP(V)	Authorized Person (Ventilation)
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
BAS	Building Automation System
BIM	Building Information Modelling
BMS	Building Management System
CAV	Constant Air Volume
CBAHI	Central Board For Accreditation Of Healthcare Institutions
CMMS	Computerized Maintenance Management System
CP(V)	Competent Person (Ventilation)



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CRAC	Computer Room Air-conditioning Unit
CRAH	Computer Room Air Handling Unit
CT	Computed Tomography
DDC	Direct Digital Controller
DOAS	Dedicated Outside Air System
DPS/T	Differential Pressure Sensor/Transmitter
DSP	District Service Provider
DX	Direct Expansion Cooling Unit
EMCS	Energy Management and Control System
EMP	Emergency Management Plan
EPA	Environmental Protection Agency
ETS	Energy Transfer Station
FLS	Fire and Life Safety System
HEPA Filter	High Efficiency Particulate Air Filter
HSSE	Health, Safety, Security, and Environment
HTM	Health Technical Memorandum
HVAC	Heating, Ventilating, and Air Conditioning
IBC	International Building Code
IEC	International Electric Code
IMC	International Mechanical Code
ISO	International Organization for Standardization
KPI	Key Performance Indicators
LEV	Local Exhaust Ventilation
LOTO	Lock Out, Tag Out
MDF	Main Distribution Frame
MRI	Magnetic Resonance Imaging
NFPA	National Fire Protection Association
NMA&FM	National Manual of Assets and Facilities Management
O&M	Operation & Maintenance
OSHA	Occupational Safety and Health Administration
PTAC	Packaged Terminal Air Conditioning Unit
RCA	Root Cause Analysis
RCL	Refrigerant Concentration Limit
RH	Relative Humidity
SBC	Saudi Building Code
ULPA Filter	Ultra-Low Particulate Air Filter
UMC	Uniform Mechanical Code
UPS	Uninterruptible Power Supply
VAV	Variable Air Volume
VFD	Variable Frequency Drive
VRF	Variable Refrigerant Flow
ZSCS	Zoned Smoke Control System

Table1: Definitions

4.0 REFERENCES

- Volume 6, Chapter 3.1, Descriptions and Definitions (EOM-ZM0-PR-000002)
- Volume 6, Chapter 5, Codes, Standard, and References (CKD -KE0-GL-000014)
- Emergency response actions (EOM-ZO0-TP-000035)
- Volume 5.5.3, Building Management System BMS
- Full generic HVAC start up procedure (EOM-ZO0-TP-000032)
- Full generic HVAC shutdown up procedure (EOM-ZO0-TP-000033)
- Full generic HVAC system monitoring/daily rounds checklist (EOM-ZO0-TP-000034)



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- National Manual of Assets and Facilities Management – Volume 5.5.1: BMS Operations – Healthcare
- National Manual of Assets and Facilities Management – Volume 10.3: Safety Requirements
- Saudi Building Code (SBC)
- SBC 201 Building Code - General
- SBC 401 Electricity Code
- SBC 501 Mechanical Code
- SBC 601 Energy Conservation
- Government Expenditure and Projects Efficiency Authority (Expro) Mechanical Design Guidelines (EPM-KEM-GL-000001)
- Health Technical Memorandum (HTM) 03-01 B – Specialized Ventilation for Healthcare Premises
- Health Technical Memorandum (HTM) 00: Policies and Principles of Healthcare Engineering
- American National Standards Institute (ANSI)/AIHA Z9.5 – Laboratory Ventilation
- ASHRAE Handbook – Fundamentals
- ASHRAE Handbook – Refrigeration
- ASHRAE Handbook – HVAC Applications
- ASHRAE Handbook – HVAC Systems and Equipment
- ANSI/ASHRAE/ASHE Standard 170 – Ventilation of Health Care Facilities
- ASHRAE Standard 15 – Safety Standard for Mechanical Refrigeration
- ASHRAE Standard 34 – Designation and Safety Classification of Refrigerants
- ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality
- ASHRAE Laboratory Design Guide 2nd Edition
- ASME Boiler and Pressure Vessel Code
- National Fire Protection Association (NFPA) 70 – National Electrical Code
- NFPA 90A – Standard for Installation of Air Conditioning and Ventilation Systems
- NFPA 92 – Standard for Smoke Control Systems
- NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- NFPA 99 – Health Care Facilities Code
- NFPA 101 – Life Safety Code

Note: Based upon the requirements on international best practices and standards. These shall be from Saudi Building code (SBC), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Health Technical Memorandum (HTM), National Fire Protection Association (NFPA), American National Standards Institute (ANSI).

These 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

The Entity is the final Authority Having Jurisdiction (AHJ) unless specifically stated otherwise in other sections of the National Manual of Assets and Facilities Management. If a conflict is discovered between these guidelines and other operations management documents, it shall be brought to the attention of the Entity who will provide a resolution or direction to evaluate if all HVAC goals and requirements have been met.

Role	Description
Management Responsibilities	The team responsible for maintaining records of the asset's condition and systems being maintained
Management	The team responsible for taking on operational ownership of the repaired, replaced, altered or extended assets or systems
Designated Person	This individual provides the essential senior management link between the organization and professional support. The Designated Person should also provide an informed position at board level.
Authorized Engineer (Ventilation) (AE (V))	The AE (V) is defined as an individual designated by management to provide independent auditing and advice on ventilation systems and to review and witness documentation on validation.



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Authorized Person (Ventilation) (AP (V))	The AP(V) will be an individual possessing adequate technical knowledge and having received appropriate training, appointed in writing by the Designated Person (in conjunction with the advice provided by the AE(V)), who is responsible for the practical implementation and operation of management's safety policy and procedures relating to the engineering aspects of ventilation systems.
Competent Person (Ventilation) (CP (V))	The CP (V) is defined as an individual designated by management to carry out maintenance, validation and periodic testing of ventilation systems.
Plant Operator	The Plant Operator is any individual who operates a ventilation installation.
End User	The end user is the individual responsible for the management of the HVAC unit in which the ventilation system is installed (for example, head of department or other responsible person).
Contractor	The contractor is the individual or organization responsible for the supply of the ventilation equipment, its installation, commissioning, or validation. This individual may be a representative of a specialist ventilation organization or a member of the general manager/chief executive's staff.

Table 2: Responsibilities

Management Responsibilities

It is a management responsibility to ensure that inspection, service and operational activities are carried out safely without hazard to staff, or members of the public. Clear lines of managerial responsibility should be in place so that no doubt exists as to who is responsible for the safe operation and maintenance of the equipment. A periodic review of management systems should take place in order to ensure that the agreed standards are being maintained.

These responsibility descriptions are given below as an example and shown in the attached organizational structure as Figure 1, Operational Responsibilities.

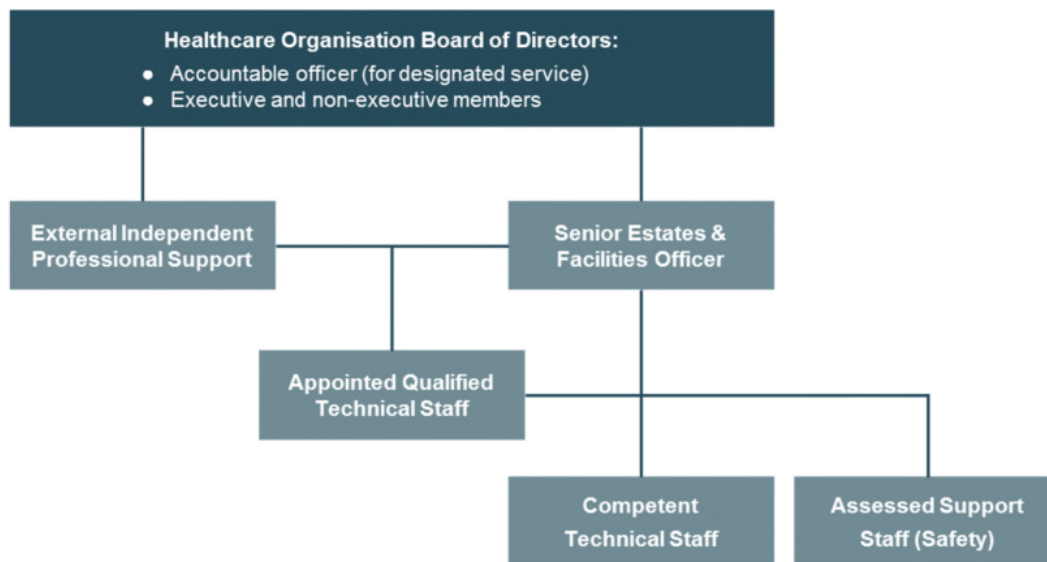


Figure 1: Operational Structure



6.0 PROCESS

6.1 HVAC Healthcare System – Functional Requirements

HVAC is used extensively in all types of healthcare premises to provide a safe and comfortable environment for patients and staff. More specialized ventilation is provided in areas such as operating rooms, critical care areas, and isolation facilities for primary patient treatment. This document provides a generic overview of the types of systems that are likely to be found within a healthcare facility. It is not intended to serve as a comprehensive standard guideline that applies to all facilities since the requirements of each facility will differ according to its particular function.

Although, suitable air conditioning is helpful in the prevention and treatment of disease, the application of air conditioning to healthcare facilities present many problems not encountered in the usual comfort conditioning design. The basic differences between air conditioning for healthcare facilities and other building type's stems from the need to restrict air movement in and between the various departments.

To meet the specific requirements for ventilation and filtration to dilute and eliminate contamination in the form of odor, air-borne microorganisms and viruses, and hazardous chemical and radioactive substances, different temperature and humidity requirements for various areas and the design sophistication are needed.

6.2 Operations Management

6.2.1 Operational Policy

The Entity Organization's Board of Directors shall be responsible for setting overall operational policies and it is the responsibility of the Designated Person (DP), as the senior executive, to implement these policies. Entity should refer to the Central Board for Accreditation of Healthcare Institutions (CABHI) in the first Instance, then the NMA&FM for facilities management.

The main recommendations for operational policy are that all ventilation plants should meet a minimum requirement in terms of the control of Legionella and safe access for inspection and maintenance. All ventilation plants should be inspected annually and the performance of all critical ventilation systems (such as those servicing operating rooms) should be verified annually.

6.2.2 Monitoring of the Operational Policy

The DP is responsible for monitoring the operational policy to ensure that it is being properly implemented. This should be carried out on a regular basis and the procedure for such monitoring should be set out in the operational policy. (Reference HTM 00: Policies and principles of healthcare engineering)

6.3 Risk Management

Critical pieces of equipment (assets) within a healthcare facility have a great impact on overall performance. Hence, it is crucial to identify what equipment is critical in ensuring the safety, comfort, and amenity of a facility, particularly in operating rooms and laboratories. The Entity may wish to plan for major plant failure by procuring critical assets such as portable air conditioning units and having a process in place to minimize downtime and inconvenience to end users.

The loss of service of these areas would seriously degrade the ability of the premises to deliver optimal healthcare. In order to ensure reliable service provisions, it is essential to inspect, verify, and maintain these HVAC systems at appropriate intervals. For many of these systems, a permit-to-work will need to be completed to ensure that taking the ventilation system out of service does not compromise the activities of the user department. In any event, it will be necessary to liaise with the user department when switching the system off to carry out routine inspection and maintenance.



6.4 Emergency Management

Emergency procedure are intended to highlight the key issues that may arise at departmental level in the event of HVAC systems failure. Good practice in emergency management should include development of an Emergency Management Plan (EMP) that outlines responsibilities, identifies high risk areas and appropriate responses, clearly identifies safe areas during an emergency and an evacuation plan for vulnerable persons, and identifies an emergency plan with response actions that will be further detailed in **Attachment 4**.

6.4.1 Operational Considerations

6.4.1.1 Health, Safety, Security and Environment (HSSE)

All safety aspects of operation associated with particular plant or equipment should be clearly understood by operational staff. Medical and other staff should be aware of the purpose of any alarm systems and of the course of action to be taken in the event of an emergency.

In order to prevent unwanted interference with plant and controls, all means of service isolation, regulation and control should be located and secured in such a way that they can be fixed in the “normal” position and be free from unauthorized adjustments. All plant rooms should be kept locked, signed, and under access control. Signage should be displayed to alert individuals that they are entering a restricted area.

6.4.1.2 Environmental

It is important to achieve a balance between economy in capital and energy costs and creating appropriate levels of comfort through mechanical ventilation/comfort cooling. Natural ventilation is always the preferred solution for a space, provided that the quantity and quality of air required and consistency of control to suit the requirements of the space are achievable. If this is not the case, a mechanical ventilation system will be required.

6.4.1.3 Records/Drawings

The Entity should have accurate and up-to-date records and/or drawings. Wherever possible, these should be backed up electronically. They should be readily available on site, in an appropriate format, for use by any AP responsible for engineering services and CP's inspecting or maintaining them. Facilities Management should also be aware of the increasing use of Building Information Modelling (BIM) and have the provisions to access BIM information where possible.

6.4.1.4 Training

All personnel employed in the operation and management of HVAC engineering services should receive adequate and documented training. Personnel should not commence their duties until this training has been completed, competency has been validated, and detailed operating instructions have been provided.

It is essential that practical training be given to all operational staff to ensure that work routines, operational procedures (including permit-to-work systems), and correct application of the safety procedures and rules are implemented.

7.0 SYSTEMS

7.1 HVAC Fundamentals

A central heating system provides thermal comfort to the whole interior of a building (or portion of a building) from one point to multiple rooms. When combined with a cooling system, in order to control the building climate, the whole system may be considered as HVAC.

HVAC, in healthcare, is also used for compliance and quality assurance of air quality supplied to areas of processing like pharmacies and sterile services departments. This is to protect staff from harmful organisms and toxic substances (e.g., in laboratories).



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Guidelines related to specific elements of central heating and cooling equipment can be found in the standards referenced below:

(ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality)

(ASHRAE Handbook – HVAC Systems and Equipment)

(ASHRAE Laboratory Design Guide 2nd Edition)

HVAC takes into consideration the following operating parameters:

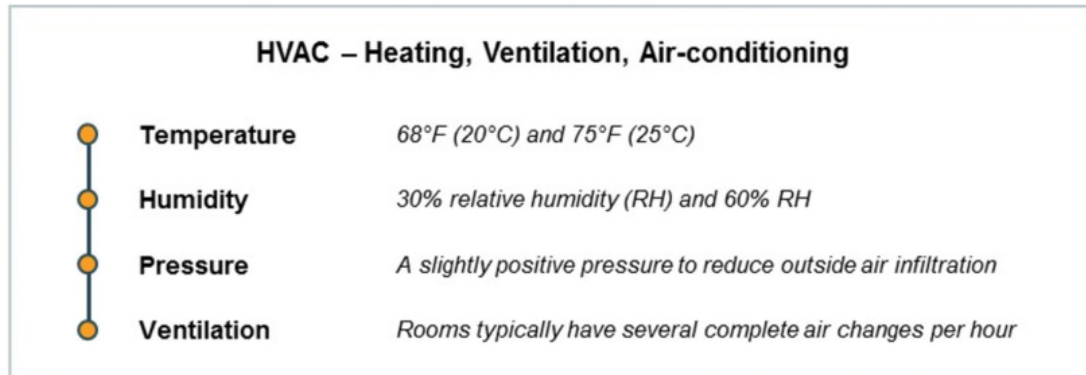


Figure 2: HVAC Heating, Ventilation, and Air-conditioning Operating Parameters

7.2 Systems Overview

7.2.1 HVAC Plant & Equipment

Users of HVAC plant and equipment need to be aware of the systems fundamentals in order to participate in the safe operation of the systems and to understand the purpose of warning alarms. They should be familiar with their arrangement and be able to start, stop and isolate in the event of an emergency. Service providers should also be current on operational techniques to increase equipment efficiency, and reliability in relation to improving the HVAC utilized in existing and new buildings with the added benefits of:

- Increased equipment life to meet with design life cycle
- Reduced downtime of plant and services through effective and targeted maintenance
- Utilization of best in class maintenance services
- Visibility of plant condition through effective reporting
- Increased performance and reduced utility costs

7.3 Building Management Systems (BMS)

All HVAC plant and equipment associated with the internal environment should, wherever possible, be monitored and controlled by a BMS. Effective systems should be in place for both off-site and on-site response to alarms.

The maintenance of HVAC systems requires integration with other discipline such as, but not limited to, the fire alarm system and related smoke control dampers. The BMS Operations - Healthcare (NMA & FM Volume 5, Chapter 5) is used for the optimization and heat recovery of HVAC equipment and the control, optimization, and monitoring of various HVAC systems.

HVAC systems Operations Management shall be completed in full accordance with the respective HSE requirement (NMA & FM Volume: 10) established by the Kingdom of Saudi Arabia, the AHJ and the Entity.

7.4 Examples of the Sub-Systems Found within HVAC



- Central Heating and Cooling
- Air Distribution System
- In-Room Terminal Systems
- Applied Heat Pump and Heat Recovery Systems
- Forced Air Heating and Direct Expansion (DX) Cooling Systems
- Steam Systems
- Hydronic Heating and Cooling
- Condenser Water Systems
- Variable-Refrigerant Flow Systems
- Dust Collection Systems
- Hydronic Heating and Cooling
- Condenser Water Systems
- Specialist Systems
- Emergency Systems

7.5 Samples of Equipment Found within System

- Direct Expansion (DX)
- Variable-Refrigerant Flow (VRF)
- Variable Air Volume (VAV)
- Computer Room Air Conditioning (CRAC)
- Constant Air Volume (CAV)
- Roof Top Units (RTU)
- Air Handling Units (AHU)
- Fan Coil Units (FCU)
- Hybrid Heat Pump
- Chilled Beams
- Local Exhaust Ventilation (LEV)

8.0 PROCEDURES

8.1 Start-up Procedure

A start-up procedure is a reference document to be used when preparing a process to operate a system from an offline position. The actions within the procedure are intended to ensure that a methodological approach is taken when bringing a potential hazardous system or piece of equipment back online. Startup procedures for HVAC shall include the following, but not limited to:

- Health and Safety
- Pre-approvals
- System Readiness
- Pre-start Checks
- Start Checks
- Notifications

(See **Attachment 1** for full generic HVAC Start up Procedure)

8.2 Shutdown Procedure

A shutdown procedure is a reference document for a planned activity to take a system or a piece of equipment offline. The shutdown procedure should be clear, prescriptive and well understood. The specific steps often mirror those taken within a startup procedure but include additional considerations for the effect on utilities and other active building services connected to the process. HVAC shutdown procedures shall include the following, but not limited to:

- Health and Safety
- Pre-approvals



- Standby System Condition
- Pre-shutdown Checks
- Routine Stop
- Post-stop Checks
- Notifications

(See **Attachment 2** for full generic HVAC Shutdown Procedure)

8.3 System's Monitoring/Daily Rounds

8.3.1 Monitoring

Facilities Management/Service Providers should consider the following items that need to be monitored:

- Key Performance Indicators (KPI) – normally agreed between the facilities management company and the Entity
- The primary sources of supply supporting a HVAC system should be monitored for any outages and their reasons recorded. In some cases, the District Service Provider (DSP) will need to be contacted directly for an explanation in the event of a prolonged power outage.
- Work Orders under the Computerized (or Paper) Maintenance Management System (CMMS) should be actioned in accordance with the agreed contract requirements.
- Assets listed in the CMMS should be audited and kept up to date as per the agreed upon contract requirements. This is to prevent the accumulation of unregistered assets not visible on the AMS system and hence, be at risk from lack of maintenance.
- Suitable trained staff shall be employed by the service provider for the purpose of monitoring plant and equipment. If the staff is not suitably qualified, competent, or available, the service provider should arrange for the appointment of an approved/authorized contractor to provide this service or support.
- Energy usage should be monitored and recorded in relation to site volume, floor area, patient numbers, and specialism i.e. Main Distribution Frame (MDF) room, Computed Tomography (CT)/Magnetic Resonance Imaging (MRI) utilization (due to high cooling usage). Seasonal variations in energy usage should also be monitored to assist in highlighting anomalies in temperature, humidity, pressure, and ventilation across the site for comparison with other similar Entities facilities

(See **Attachment 3** for full generic HVAC System Monitoring/Daily Rounds Checklist)

8.4 Emergency Response Actions

The aim of these emergency procedures is to provide guidance and a structured approach to the management response in the case of a major failure of a HVAC system and to safeguard users/patients from any such failure.

The following procedures are designed to instruct and advise on the operational requirements for dealing with such a compromised ventilation system. It is not considered a definitive guide on emergencies as the specific circumstances of the incident will ultimately determine the course of action taken.

8.4.1 Airborne Contamination

8.4.1.1 Causes

HVAC ventilation may become compromised by contamination in several ways including but not limited to:

- Contamination of the incoming air supply to the healthcare facility.
- Contamination caused by the corrosion or decay of materials in contact with the ventilation ductwork; (for example rusting metal and vermin)



- Cross-contamination of ventilation supply following failure of a process not carried out correctly on site by staff, or contractors where the safety protocols are inadequate or non-existent; (for example cross-contamination due to an unauthorized plant shutdown and loss of pressure)

8.4.1.2 Effects

The possible effects of a compromised system are varied and will depend on the severity and degree of the contamination, however a further investigation should be carried out if:

- Users complain about the condition of the supply air or it is discolored.
- The supply air has a distinctive odor (this could be the result of chemicals (for example, chlorine or decaying matter))
- The supply air appears normal but people using it have become sick/infected.

8.4.1.3 Response Actions

- Staff should safely complete or suspend any work being undertaken and prioritize their attention on the most critical equipment and/or patients. Local standby supplies and equipment-based systems should be checked. Wherever necessary, manual intervention should be made to ensure the safety of users and patients.
- When supply is restored, the AP (V) should ensure that all essential equipment is functioning correctly and where necessary, transfer equipment onto essential supplies. On restoration of the primary supply, the AP (V) should check that all systems and equipment have reset to normal.

8.4.1.4 Investigation

- The size of the affected area must first be ascertained. This will give some indication of the extent of the problem and may help to identify the source of the contamination. Further actions may or may not be required, depending on whether part of or the whole ventilation system has been compromised.
- Inform the senior management of affected departments to cease using the system. Once the extent has been determined, an assessment should be undertaken as to identify the nature of the contamination. It is advised that the infection control officer is involved

8.4.1.5 Damage Control

- The cause and result of the damage to the system should be investigated by the Authorized Engineer/Authorized Person. AP (V). Drawings and schematics should be readily available.
- Steps should be taken to limit the amount of disruption, and temporary back-up systems should be protected by either sealing off damaged areas during repairs. Following damage limitation, Lock Out Tag-Out (LOTO) the damaged section wherever possible and ensure back-up support is functioning.

8.4.1.6 Debriefing

- Following return to normality, a team debriefing should be held to review the emergency procedure and update or correct any apparent weaknesses

8.4.1.7 Review Procedure

- This procedure will be reviewed following any change in personnel, equipment, materials and environment or following any change. It will be reviewed at regular intervals not exceeding 12 months
- Where deemed necessary a Root Cause Analysis (RCA) should be undertaken to understand the event or sequence of events leading to a failure and allow a review of current practices to be undertaken. Implementing improvement or change where this may be found as necessary.



8.4.1.8 Training and Information

- All staff involved will receive adequate training and instruction to enable them to carry out these procedures with confidence during an emergency. This training will be recorded in a formal training log, and updated on a regular basis

8.4.1.9 Exemplar Template Procedures and Checklists

The following procedures and checklists have been prepared for facilities management personnel to meet the needs of their own organizations during failure of a system.

They are not intended to be appropriate or definitive for all facilities but they give an idea of the types of format that may be used and the different levels of technical content that may be appropriate on contrasting sites.

Further procedures will be required within a healthcare Entity and a regular review is important to ensure that the directives of staff and equipment remain current. (See **Attachment 4** for full Emergency Response Actions/Plans)

9.0 ATTACHMENTS

1. EOM-ZO0-TP-000027: Start-up Checklist HVAC Systems – Healthcare Template
2. EOM-ZO0-TP-000028: Shutdown Checklist HVAC Systems – Healthcare Template
3. EOM-ZO0-TP-000029: Systems Monitoring/Daily Rounds HVAC Systems – Healthcare Checklist
4. EOM-ZO0-TP-000030: Emergency Response Action HVAC Systems – Healthcare Checklist



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Attachment 1 – EOM-ZO0-TP-000027 Start-up Checklist HVAC Systems – Healthcare Template

Hospital Name:		Reference No.	REV-000		
No.	Start Up Checklist	CHECKED SATISFACTORY			
		N/A	YES	NO	
Health and Safety					
1	Required Personal Protective Equipment (PPE) available	☐	☐	☐	
2	Risk Assessments Method Statement (RAMS) available	☐	☐	☐	
3	Chemical Material Safety Data Sheets & Product Data Sheets (MSDS & PDS) checks available	☐	☐	☐	
4	Location of first-aid instructions and supplies available	☐	☐	☐	
5	Emergency eyewash and showers available	☐	☐	☐	
6	Emergency evacuation plan reviewed	☐	☐	☐	
7	Emergency contact details of the authorized person and the contractors	☐	☐	☐	
8	Life safety systems (fire extinguishers, sprinklers, gas suppression and fire alarm)	☐	☐	☐	
9	Ventilation	☐	☐	☐	
Pre-approvals					
10	System owner/manager/engineering teams' approvals available	☐	☐	☐	
11	End-user department head's approvals available	☐	☐	☐	
12	Quality, Health, Safety and Environment (QHSE) management approvals available	☐	☐	☐	
13	Specialist contractor schedule of work	☐	☐	☐	
14	Approved permit to work (PTW)	☐	☐	☐	
System Readiness					
15	System pressure checks	☐	☐	☐	
16	System temperature checks	☐	☐	☐	
17	Humidity levels checks	☐	☐	☐	
18	System is hazardous free and no leaks checks	☐	☐	☐	
19	Condense test kit checks	☐	☐	☐	
20	Filter stocks and expiry checks	☐	☐	☐	
21	Required tools checks	☐	☐	☐	
22	Lock Out, Tag Out (LOTO) checks	☐	☐	☐	
23	Confirm with schematic and Building Management system (BMS)	☐	☐	☐	
24	Areas are cleaned and egress checks	☐	☐	☐	
Pre-start Checks					
25	System fault free/alarm free checks	☐	☐	☐	
26	Original Equipment Manufacturers (OEM) startup procedure available	☐	☐	☐	
27	Automatic controller checks	☐	☐	☐	
28	Parameters set point checks	☐	☐	☐	
29	Magnahelic gauge checks	☐	☐	☐	
30	Frost coil checks	☐	☐	☐	
31	Heater batteries visual inspection checks	☐	☐	☐	
32	Previous service reports checks (third party specialist)	☐	☐	☐	
33	Primary supplies systems/plants checks	☐	☐	☐	
34	Grease levels checks	☐	☐	☐	
35	Mechanical schematic diagrams	☐	☐	☐	



Attachment 2 – EOM-ZO0-TP-000028 Shutdown Checklist HVAC Systems – Healthcare Template

Hospital NAME:		Reference No.	REV-000		
No.	Shut Down Checklist	CHECKED SATISFACTORY			
		N/A	YES	NO	
Health and Safety					
1	Required Personal Protective Equipment (PPE) available	☐	☐	☐	
2	Risk Assessments Method Statement (RAMS) available	☐	☐	☐	
3	Chemical Material Safety Data Sheets & Product Data Sheets (and PDS) checks available	☐	☐	☐	
4	Location of first-aid instructions and supplies available	☐	☐	☐	
5	Emergency eyewash and showers available	☐	☐	☐	
6	Emergency evacuation plan reviewed	☐	☐	☐	
7	Emergency contact details of the responsible person and the contractors	☐	☐	☐	
8	Life safety systems (fire extinguishers, sprinklers, gas suppression and fire alarm)	☐	☐	☐	
9	Ventilation	☐	☐	☐	
Pre-approvals					
10	System owner/manager/engineering teams' approvals available	☐	☐	☐	
11	End-user department head's approvals available	☐	☐	☐	
12	Quality, Health, Safety and Environment (QHSE) management approvals available	☐	☐	☐	
13	Specialist contractor schedule of work	☐	☐	☐	
14	Approved permit to work	☐	☐	☐	
Standby System Condition					
15	System operating condition checks	☐	☐	☐	
16	System leakage free checks	☐	☐	☐	
17	System faults/alarm free checks	☐	☐	☐	
18	Water flow checks	☐	☐	☐	
19	Systems parameters checks	☐	☐	☐	
Pre-shutdown Checks					
20	System is alarm free checks	☐	☐	☐	
21	Automatic control panel parameters check	☐	☐	☐	
22	Set points checks	☐	☐	☐	
23	Pressure gauges	☐	☐	☐	
24	Magnahelic gauge checks	☐	☐	☐	
25	Heat recovery checks	☐	☐	☐	
26	All related valves open-closeout checks	☐	☐	☐	
Routine Stop					
27	Lock Out, Tag Out (LOTO) remove checks	☐	☐	☐	
28	Stop fan using Building Management system (BMS)	☐	☐	☐	
29	Stop water supply	☐	☐	☐	
30	Stop electrical power supply	☐	☐	☐	
31	Close valves checks	☐	☐	☐	
Post Stop Checks					
32	Open basin drains valves	☐	☐	☐	
33	Air quality parameters checks	☐	☐	☐	
34	Identification of broken/damaged pipeline checks	☐	☐	☐	



HVAC Systems Operations – Healthcare Procedure

Attachment 3 – EOM-ZO0-TP-000029 Systems Monitoring/Daily Rounds HVAC Systems – Healthcare Checklist

Hospital Name:		Reference No.	REV-000		
No.	Systems Monitoring / Daily Rounds Checklist	CHECKED SATISFACTORY			
		N/A	YES	NO	
	Introduction:				
	This monitoring checklist is intended to highlight the key issues that may arise day to day at the local level. The procedure and any supporting information should be reviewed and amended as necessary to ensure that the document remains up-to-date and definitive for the facility.				
1	System inspection and checking: is the plant running?	☐	☐	☐	
2	System assessment: is the unit and its associated plant secure from unauthorized access?	☐	☐	☐	
3	Remote monitoring of ventilation and air conditioning systems and equipment - Building Management System (BMS)	☐	☐	☐	
4	Identifying maintenance risks on equipment and rising work orders	☐	☐	☐	
5	Investigating faults/alarms for HVAC systems	☐	☐	☐	
6	Cleaning and adjusting of system	☐	☐	☐	
7	Performing emergency repairs promptly and efficiently	☐	☐	☐	
8	Providing technical direction to ensure system maintains online	☐	☐	☐	
9	Keeping daily logs and records of all maintenance functions	☐	☐	☐	
10	Ensuring compliance with appliance standards and with occupational health and safety	☐	☐	☐	
11	Complying with service standards, work instructions and user requirements	☐	☐	☐	
No.	Reviewer's Comments	Resolution			
Originator's Name/Signature and Date:		Checker's Name/Signature and Date:			



HVAC Systems Operations – Healthcare Procedure

Attachment 4 – EOM-ZO0-TP-000030 Emergency Response Action HVAC Systems – Healthcare Checklist

Building NAME:		Reference No.	REV-000		
No.	Emergency Response Actions	CHECKED SATISFACTORY			
		N/A	YES	NO	
	HVAC Systems – Healthcare				
	Introduction				
	This emergency procedure is intended to highlight the key issues that may arise at departmental level in the event of HVAC systems' failure. It is appreciated that this may be a result of a full site system's failure, but it may also be the result of a local failure for which notification from the Entity maybe necessary. The main aim is to provide a structured approach to safety of employees, patients, and the general public for minimizing the risks associated with an HVAC systems' failure				
Priority 1	Life safety (Evacuation Plan)	☐	☐	☐	
Priority 2	Stabilization of incident	☐	☐	☐	
Priority 3	Minimize potential damage	☐	☐	☐	
Priority 4	Containment of incident (Example: contamination of the incoming air supply)	☐	☐	☐	
Priority 5	Damage Assessment	☐	☐	☐	
Priority 6	Clean-up after the incident (Post-Incidents Plans)	☐	☐	☐	
Priority 7	Designated Person to monitor weather sources for updated emergency instructions and broadcast warnings if any, issued by the weather services	☐	☐	☐	
Priority 8	Building lockdown Plan/Plant lockdown plan	☐	☐	☐	
1	The Designated Person shall conduct an initial and ongoing situational assessment of the incident.	☐	☐	☐	
2	The Designated Person shall establish an effective communications plan	☐	☐	☐	
3	The Designated Person shall deploy available resources and request additional resources based on the needs of the incident.	☐	☐	☐	
4	The Designated Person shall develop an incident organization for the management of the incident	☐	☐	☐	
5	The Designated Person shall review, evaluate, and revise the strategy and tactics based on the needs of the incident.	☐	☐	☐	
6	The Designated Person shall provide for continuity, transfer, or termination of commands	☐	☐	☐	
7	The procedures shall provide for a routine process of escalation as additional resources are required / utilized.	☐	☐	☐	
8	The Designated Person shall determine what levels and elements of the incident management system are to be implemented in each case and shall develop the command structure for each incident by assigning supervisory responsibilities according to standard operating procedures (SOPs)	☐	☐	☐	
9	The Incident Management Plan shall define standardized supervisory assignments	☐	☐	☐	
10	The Designated Person for incidence shall be responsible for controlling communications on the tactics, commands, and designated emergency traffic channels for the incident	☐	☐	☐	
11	The Designated Person for incident shall be responsible for overall responder's accountability for the incident	☐	☐	☐	
12	The Designated Person for incidence shall be responsible for developing and/or approving an incident action plan (IAP)	☐	☐	☐	
13	The Designated Person for incidence shall keep the safety officer informed of strategic and tactical plans and any change in situations	☐	☐	☐	
14	The Designated Person for incidence shall evaluate the risks to responders with respect to, the purpose and potential results of their actions in every situation	☐	☐	☐	
15	The communication system shall provide a standard methods to prioritize the transmission of emergency messages and notification of imminent hazards over that of routine communications, to all levels of the incident commands structure	☐	☐	☐	