NHS National Services Scotland

Scottish Health Technical Memorandum 08-05:

Specialist services
Building management systems
Part A
Overview and management responsibilities

Health Facilities Scotland
Engineering and Environment

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Contents

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Acknowledgements

This new SHTM 08-05 Part A: 'Overview and management responsibilities' has been developed, updated and expanded from SHTM 2005 which it replaces. SHTM 2005 was originally published in June 2001 by NHSScotland Property and Environment Forum Executive. The contributions from the National Ventilation Advisory Group and Stuart Robertson of Enterprise Control Engineers Ltd. are gratefully acknowledged.

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Preface

About Scottish Health Technical Memoranda

Engineering Scottish Health Technical Memoranda (SHTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

The focus of SHTM guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle: Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Scottish Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to repeat unnecessarily international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Scottish Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of eight subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.

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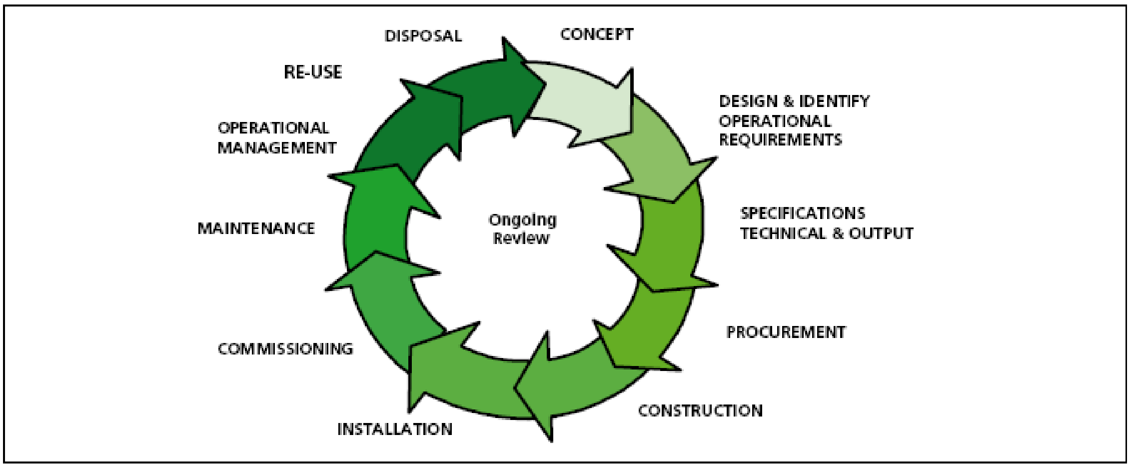

Healthcare building life-cycle

Structure of the Scottish Health Technical Memorandum suite

The series of engineering-specific guidance contains a suite of eight core subjects:

Scottish Health Technical Memorandum 00: Policies and principles (applicable to all Scottish Health Technical Memoranda in this series)

Scottish Health Technical Memorandum 01: Decontamination

Scottish Health Technical Memorandum 02: Medical gases

Scottish Health Technical Memorandum 03: Heating and ventilation systems

Scottish Health Technical Memorandum 04: Water systems

Scottish Health Technical Memorandum 05: Reserved for future use

Scottish Health Technical Memorandum 06: Electrical services

Scottish Health Technical Memorandum 07: Environment and sustainability

Scottish Health Technical Memorandum 08: Specialist services

Some subject areas have been further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Scottish Health Technical Memorandum 06-02 Part A represents: Electrical safety guidance for low voltage systems

In a similar way Scottish Health Technical Memorandum 07-02 simply represents: Environment and Sustainability – EnCO_2de.

All Scottish Health Technical Memoranda are supported by the initial document Scottish Health Technical Memorandum 00 which embraces the management

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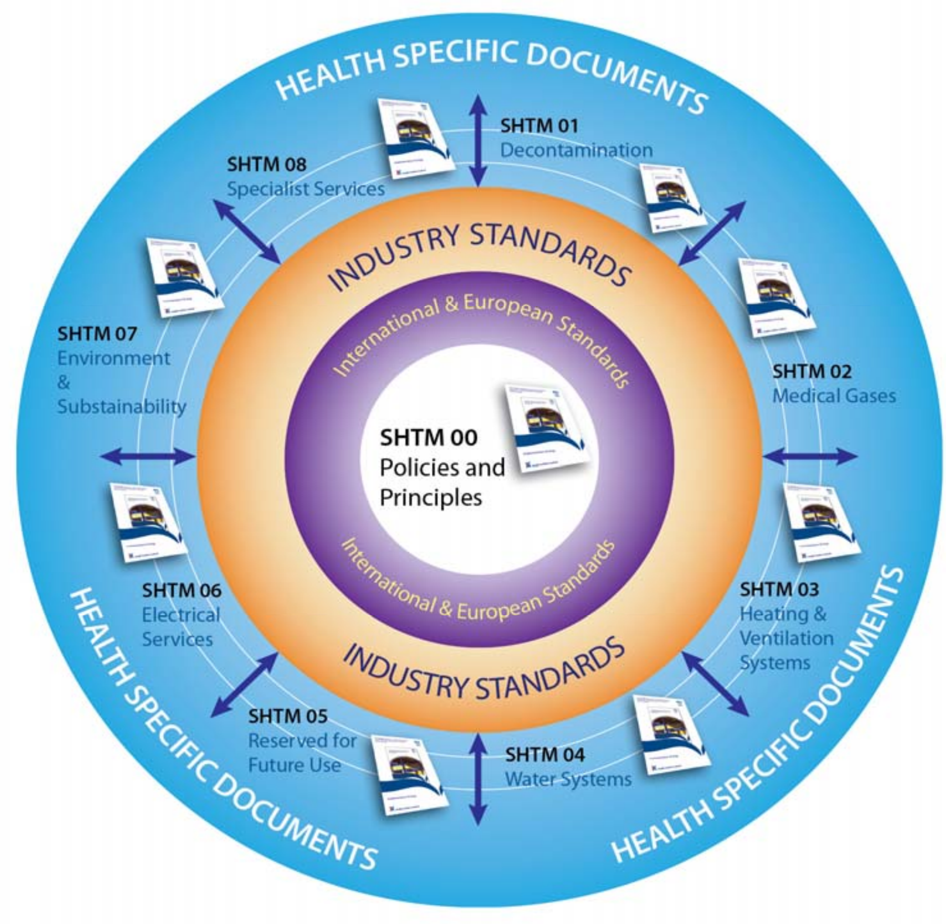
and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.

Health Facilities Scotland wishes to acknowledge the contribution made by professional bodies, engineering consultants, healthcare specialists and NHS staff who have contributed to the review.



Engineering guidance

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Executive summary

A building management system (BMS) or Building and Energy Management System (BEMS) is a computer-based centralised procedure that helps to manage, control and monitor certain engineering services within a building or a group of buildings. Such a system ensures efficiency and cost-effectiveness in terms of labour and energy costs, and provides a safe and more comfortable environment for building occupants.

The BMS has evolved from being a simple supervisory control to a totally integrated computerised control and monitoring system.

Some of the advantages of a BMS are as follows:

- simple operation with routine and repetitive functions programmed for automatic response;
- reduced operator training time through on-screen instructions and supporting graphic display;
- faster and better response to occupant needs;
- reduced energy costs through centralised control and energy management programmes;
- better management of the facility through historical records, planned maintenance programmes and automatic alarm reporting;
- improved operation through software and hardware integration of multiple sub-systems, for example direct digital control, security, access and lighting controls.

This part, 'Overview and management responsibilities', outlines the overall responsibility of chief executive officers and managers of healthcare premises, and details their legal and mandatory obligations in installing and operating a reliable, efficient and economic BMS.

Management responsibilities in terms of compliance with statutory instruments are summarised in Section 2. Technical aspects are described very briefly in this document, concluding with guidance on the management of systems. The technology and potential benefits of a BMS are described in Section 3, 'Functional overview'. A synopsis of testing and inspection, together with an outline on commissioning and handover procedures, is included in Section 4.

Section 5 draws the attention of management to BMS applications and advice is given on selection of maintenance contractors and training.

Sections 6 and 7 deal respectively with selected staff functions and definitions.

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1. Scope

1.1 A building management system (BMS) is a management tool for the effective control of building engineering services, and can be applied equally to new and existing buildings.

1.2 A BMS can be used to manage the environmental conditions of all types of building. In healthcare premises, increasing energy efficiency, reducing CO_2 emissions and saving costs are a mandatory daily task. A BMS is particularly valuable in maintaining climate control and suitable conditions in critical areas, for example operating departments, intensive care units, isolation suites, pharmacies and sterile supply departments. A BMS provides alarm communication networks for the building services plant and equipment.

1.3 A properly installed and maintained BMS operated by fully trained staff offers considerable opportunities for 'energy and carbon management'. A BMS can support separate software packages for energy monitoring and targeting and also data evaluation and reporting. Consideration should also be given to web-based energy performance monitoring, reporting and analysis tools.

Note: Other areas that can be monitored and targeted include water consumption, sewage and waste disposal. As energy management is an important tool, installations are often described as 'Building and energy management systems' (BEMS). However, the abbreviation 'BMS' is used throughout this document. Section 7: 'Definitions' also refers.

1.4 A further use of the BMS is to help to establish the basis of a site's planned preventive maintenance operations.

1.5 A BMS should be specified with care and detail, focusing on the functionality and required performance of the systems under control, optimising the workflows and service processes to be more efficient. The specification should detail the commissioning and handover requirements. When a BMS is specified, especially if it is replacing existing controls, consideration should be given to the appropriate level of user control.

Note: When a BMS is specified, the NHS Model Engineering Specifications, with appropriate supplements for Scotland, should be considered.

1.6 The commissioning of a BMS should be fully documented to ensure that all aspects of the system meet the specification. Adequate resources should be allocated to ensure satisfactory commissioning procedures are met.

1.7 To continue to meet specified environmental conditions and increase energy efficiency, a BMS should be regularly maintained and its performance tested.

1.8 It is important that BMS operators and maintenance staff receive adequate training as technical malfunctions have to be detected on time and reported so that appropriate measures can be immediately carried out.

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1.9 The sophistication of building services in healthcare premises is increasing, with the task of combining energy efficiency and carbon usage reduction with comfort and secure energy supply. The BMS controls should be designed, installed, operated and maintained to standards that will enable the controls to fulfil the desired functions reliably, safely, economically and efficiently.

1.10 BMS controls should be designed to standards for the full spectrum of today's building services applications in keeping up with new energy-efficient technologies, with system functions such as alarm management, time scheduling, and trend logging, combined with sophisticated control functions, Intelligent networking of information and communication technology as well as web technology and open communications making a financially wise investment for the future.

1.11 The design of the BMS controls should be consistent in its support of open communications, making it easy to connect a wide variety of building services equipment on the basis of standard open data interfaces;

- BACnet;
- LONWORKS®;
- Konnex (KNX);
- M-bus;
- Modbus;
- OPC;
- TCP/IP network protocol.

Note: 1. BMS controls should allow access to systems from any (remote) site.

2. The use of 'virtual servers' offers a greater degree of protections from systems crashing, impact of IT updates etc., relating to system security

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2. Management responsibilities

2.1 It is incumbent on management to ensure that their BMS installations comply with all the statutory regulations applicable to a BMS on their premises. Other functional guidance in terms of standards and codes of practice should also be noted.

Statutory requirements

2.2 Safety regulations are as laid down in the following:

- Health and Safety at Work etc (HSW) Act 1974;
- Electricity at Work Regulations 1989;
- The Building (Scotland) Regulations 2004;
- Management of Health and Safety at Work Regulations 1999;
- Provision and Use of Work Equipment Regulations 1998;
- Manual Handling Operations Regulations 1992;
- Workplace (Health, Safety and Welfare) Regulations 1992;
- Personal Protective Equipment at Work (PPE) Regulations 1992;
- Health and Safety (Display Screen Equipment) Regulations 1992;
- Construction (Design and Management) Regulations 2007;
- Electromagnetic Compatibility Regulations 2005.

Functional guidance

2.3 Guidance is as laid down in:

- British Standards and Codes of Practice;
- Health and Safety Executive Guidance;
- NHS Model Engineering Specifications;
- Scottish Health Technical Memoranda (SHTMs);
- Scottish Hospital Planning Notes (SHPNs);
- Scottish Hospital Technical Notes (SHTNs);
- NHS in Scotland – Firecode suite;
- Health Building Notes still applicable in Scotland

For further details please refer to the 'References' section at the end of this document.

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3. Functional overview

Introduction

3.1 A BMS controls the plant and equipment creating the internal environment in healthcare premises. It typically consists of a central station connected via a communications network to a number of outstations (see Figure 1). Control actions can be determined by either the central station or outstations. The latter can operate independently of the network if necessary; hence the term “distributed intelligence”. Provision should be made for system expansion capacity to be provided as a base requirement, or the ability to allow additions at a later date without incurring radical system upgrades of changes.

Note: 1.The extent and geography of the site will determine the choice of the equipment and communications network to be used. Links from the central station to remote outstations can be achieved by, for example, hard wire, and modem or radio communication. However, it is critical to ensure that sensitive medical electrical equipment is not affected by radio communication interference. (Refer to the HEEU report ‘Electromagnetic Compatibility of Medical devices with Mobile Communications’ issued 9/5/97).

2. It is recommended that uninterruptible power supplies (UPS) are included for the central station, outstations and any communications network. The battery system autonomy will vary with the application from 2-3 minutes to 1 hour.

BMS technology

Central station

3.2 The central station of a BMS is usually a personal computer-based system to provide a graphical, real-time, user interface for the building control system. It enables the user to monitor plant or building services, and make changes to the way the building is controlled from a graphical display. All pages and actions are accessible using a mouse. The security system ensures that users are only presented with information and functions that are relevant to their authority or task.

The central station of a BMS provides:

- the ability to establish trend logs of various monitored parameters such as sensor values or control outputs. This feature can be invaluable when investigating the performance of plant;
- the ability to receive plant alarms and abnormal conditions warnings which can be graded by degree of severity and required response;
- the ability to alter control parameters such as programmed occupancy times

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or control set-points;

- the ability to configure the system, including the outstations;
- the use of management software for energy monitoring and targeting and for maintenance planning;
- the ability to monitor all connected plant. Hard copy reports can be generated and printed.

Note: 1. The technical specification of the central station is of vital importance to enable it to operate additional management software for monitoring and targeting purposes.

2. Incorporation of 'virtual servers' would obviate the requirement for personal desk-based computers. (paragraph 1.11 also refers).

Outstation

3.3 An outstation is a microprocessor device which uses programmable software to perform control functions. The outstation software provides control 'blocks' which can be arranged (configured) to provide a control strategy. Once configured, the outstation is able to hold the control logic.

3.4 A number of inputs and outputs are connected to each outstation. Inputs include on/off status of plant, and data from sensors measuring temperature, humidity, pressure, velocity etc. Outputs include on/off signals to plant, along with control signals to actuators for valves and dampers etc.

Note: One or more outstations may be used to control the engineering services plant in a particular building.

3.5 Outstations are connected to a communications network. This enables data to be shared between outstations and provides a means of accessing and monitoring the system from a single point.

Unitary controllers

3.6 Unitary controllers are small outstations generally dedicated to one item of plant (i.e. fan coil units, VAV units, etc) and are connected to the communications network. Unitary controllers should be 'freely programmable' and totally flexible allowing reconfiguration of software loops/applications to be completely reprogrammed by the operators from the central (BMS).

Control functions

3.7 Control functions available for configuration depend on the make of outstation and typically include:

- time/event schedules;
- optimisers;

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- compensators;
- proportional, integral and derivative control;
- logic functions.

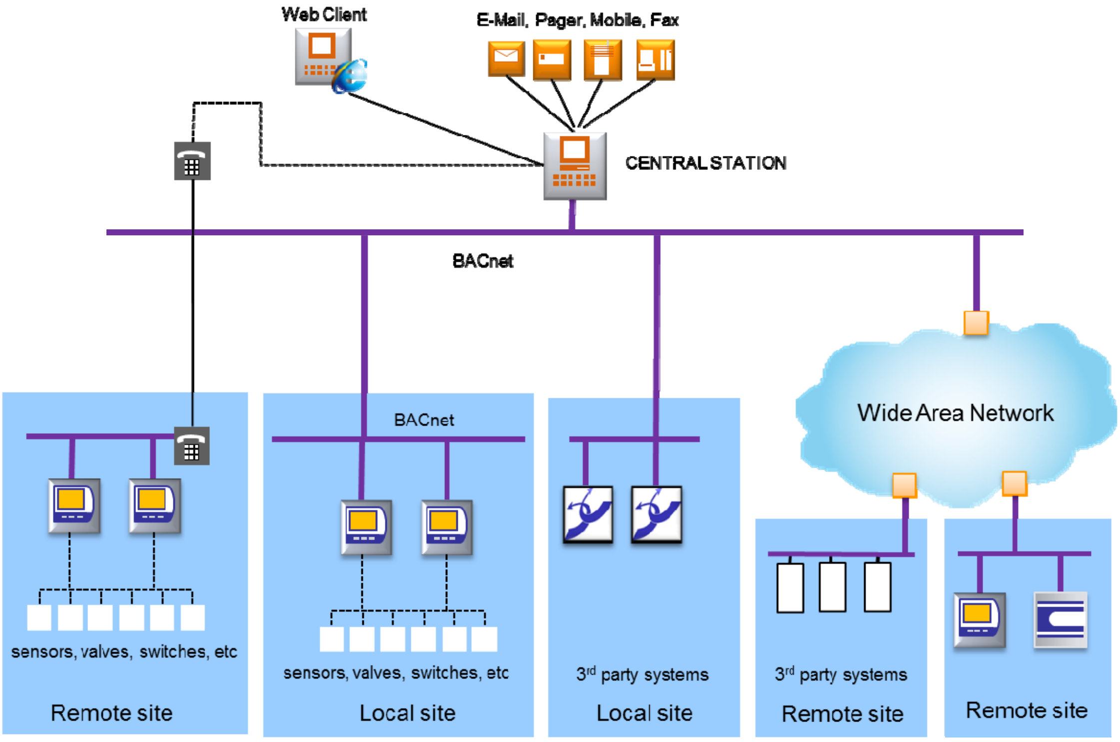

Figure 1: Building management system with remote access schematic

3.8 These various functions can be configured together to provide a tailored control strategy to suit the plant in question. Typical control applications include:

- heating;
- ventilation;
- mechanical cooling /air-conditioning;
- lighting;
- duty cycling;
- load shedding.

Potential benefits of a BMS

To reduce the carbon usage and maximise the energy-saving potential of a BMS, its ability to control plant and associated systems should be fully exploited.

Note: Improved monitoring alone may not necessarily save energy.

3.10 A BMS can provide enhanced control of environmental conditions. This is achieved by the flexibility in configuration of programmes which can be tailored to provide optimum control solutions. The ability to record or log measured or

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calculated parameters over time provides a powerful auditing tool which can be used to check and refine the control settings.

3.11 The logging facility is invaluable for energy auditing and checking the control of an item of plant or space condition. A permanent record can be made of environmental conditions through the use of logs.

3.12 A BMS can be configured such that any monitored parameter can signal an alarm once a predetermined value has been exceeded. The type of abnormal condition can be specified, as can the nature of the associated alarm and required response. This facility gives the BMS a fault detection capability which can be extended to other hospital equipment, for example fume cupboards, freezers and lifts.

Note: It is essential to ensure that the BMS interface with 'lifts' processors is restricted to monitoring only. Any possibility of the BMS influencing the lifts' controls must be eliminated.

3.13 A BMS can be configured to log the hours run by a particular item of plant and the number of starts. This data and other information collected by a maintenance management software package can be used to schedule plant maintenance. Messages from the BMS can also be used to initiate repair and maintenance instructions.

3.14 Improved monitoring and control of plant with a BMS improves the life of the plant, reduces maintenance costs and enables better use of existing engineering labour resources.

3.15 Proprietary software for monitoring and targeting can be installed at the central station. This software can be a powerful tool in an energy-saving campaign as it not only provides an analysis of energy use, but also highlights energy wastage and deviations from set targets.

3.16 A BMS can provide a central monitoring facility for a range of related systems such as:

- fire detection;
- security detection systems, including burglar alarms, closed circuit television (CCTV) and access control systems;
- telephone systems;
- vertical transport systems (lifts).

3.17 At present a BMS performs no control role when integrated with any of the above; it merely acts as a single user interface, monitoring autonomous systems. There needs to be a clear technical break (isolation) between fire alarm/protection systems and the BMS to ensure the absolute integrity of the fire alarm system. The level of integration is restricted at present due to current standards and the advice of fire prevention and building control officers. It is also essential that the BMS interface with 'lifts' processors is restricted to

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monitoring only. Any possibility of the BMS influencing the lifts' controls must be eliminated.

3.18 In healthcare premises procured by means of Public Private Partnership or Private Finance Initiative (PPP/PFI) the responsibility for the BMS and maintenance of plant being controlled or monitored will rest with the Facilities Management Provider. In these situations the NHS Board's own estates management should still have access to all BMS information albeit on a 'read-only' basis.

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4. Testing and inspection criteria

General

4.1 Management should be aware of the importance of thorough and complete commissioning of an installed BMS before it is formally handed over and put into use. Since the BMS contributes to safe and comfortable environmental conditions for the buildings' occupants, it is essential that the system is fully commissioned.

4.2 When a BMS installation is part of a larger project, the commissioning, particularly of the BMS, is one of the last tasks in the construction process. If the project overruns, the programmed resources tend to be compressed. This should be strongly resisted as it can result in a poorly commissioned BMS which is ineffective, energy-inefficient, and which can suffer from false alarms, resulting in complaints from the occupants. Much time, cost and effort will then be expended to resolve the problems.

Commissioning

4.3 The commissioning process is defined as the activity where the complete BMS is moved from a condition of static completion to a state of dynamic operation to provide functional and environmental control of the process within the design parameters. Commissioning incorporates several stages:

- pre-commissioning checks of the components:
  - wiring;
  - sensors and actuators;
  - major sub-assemblies (either on or off site);
  - control cabinets;
  - configured control strategies;
  - central station graphics slides;
- commissioning of the application software;
- commissioning of the complete system including:
  - checking alarms;
  - checking interlocks;
  - control loop tuning;
  - calibration of sensors;

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- performance tests, for example, load tests on cooling systems, to check the ability of the system to meet specified environmental performance parameters.

4.4 The commissioning of a BMS should only begin once the plant to be controlled has been fully tested and approved for work.

4.5 Commissioning should be undertaken by a BMS specialist and therefore should preferably be an approved partner to the BMS manufacturer of the system installed.

Specification

4.6 The BMS specification deals with the scope of the BMS specialist supplier/sub-contractor. It is intended to be a stand-alone document. However it should be read in conjunction with all other contract documents. The specification should require that the BMS is commissioned systematically by the application of a commissioning procedure and the relevant code of practice. The completion of commissioning record sheets should be specified as a part of verification.

Commissioning documentation

4.7 Record sheets should be completed to verify that items are commissioned and to create a permanent record for future reference. Variations should be noted and drawings and other documentation updated during the commissioning process to create a set of 'as-installed' records.

Handover procedures

4.8 Handover requirements should be detailed in the specification. The client should witness the demonstration of various aspects of the BMS to their satisfaction. The handover procedure also includes the provision of all specified documentation including:

- record drawings;
- schematics;
- points lists;
- commissioning records;
- operating and maintenance manuals.

> **Note:** For this purpose, the client needs to be informed and should have already received some training. Involvement in the commissioning process of client's key staff can consolidate his informed status.

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Seasonal commissioning and fine tuning

4.9 The BMS should be fully commissioned as soon as the contract work is completed regardless of season. During the first year of operation the performance of the BMS will need to be optimised through a process of fine tuning. This is partly because the BMS most probably will have been commissioned before the building was occupied, and invariably set-points and other items will need adjusting. The BMS should be revisited at a peak period during each season to observe full-load performance and to ascertain adequate performance during the different seasons. It would be estimated that this be carried out over a 3 day period for each season or at 3, 6 and 9 month intervals to suit the client.

Note: Seasonal commissioning (and consequent fine tuning carried out by the BMS contractor), is a BREEAM requirement..

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5. Management summary

General

5.1 The guidance contained in this SHTM is not intended to be applied retrospectively. However, there is an obligation to review existing installations and ensure that they are of a satisfactory standard. The guidance should be applied in full to new installations and major refurbishment of existing installations.

5.2 Management should be aware of the range and type of building engineering services controlled by a BMS, as this will provide an understanding of the importance of the system.

5.3 To have a reliable and efficient BMS, management should ensure that the specification, commissioning, handover, maintenance and operation are to a high and appropriate standard.

Application considerations

5.4 Management should conduct a feasibility study before specifying BMS control. In a new building the size and complexity of the plant will dictate whether a BMS is suitable. An additional factor is the existence of a BMS on the site and the desire to connect new buildings to the system.

Note: A BMS is not always the most cost-effective control solution.

5.5 The replacement of an existing control system with a BMS should be subject to a 'value for money' and 'cost/benefit' analysis. Where this is the case, the replacement may be justified by other benefits, such as plant and alarm monitoring. Often, a BMS can interface with an existing effective control system, thus reducing overall cost. Where a BMS is to be installed into an existing building, every effort should be made to minimise disruption to existing plant operation.

5.6 For a BMS to function effectively, data must be transferred around the system and, in many cases, to and from other systems. To provide a means for the transfer of data, communication protocols are required. These protocols permit the physical connection, transfer and interpretation of data. Major BMS companies often implement different communication protocols, with the result that equipment from different manufacturers may not communicate directly. This can present several problems, including:

- if systems are implemented from a single supplier, there may not be the opportunity to select the 'best' equipment for specific applications;

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- by being tied to a single make of equipment, best value for money may not be realised;
- separate interfaces will be required if equipment is supplied by a number of different manufacturers.

Note: Competitive tendering can be achieved through the use of systems houses (controls companies that market, design and install control equipment from several different BMS companies) or by requiring the tender to include for additional BMS equipment to be index-linked over a specific number of years.

5.8 The formulation of standardised protocols is the subject of protracted discussions within international bodies. A partial solution to the problems of transferring data between different systems is to use a gateway. Essentially, a gateway can be thought of as a 'black box' which is placed between dissimilar systems to give a degree of interconnection and to enable a certain amount of interaction. However, the use of gateways presents several potential problems, such as:

- high cost of engineering the gateway;
- loss of functionality;
- gateway maintenance and accommodation of protocol variations;
- contractual issues, that is, who has ultimate responsibility for the gateway?

Functional objectives

5.9 Management should ensure that the relevant parties receive a sound briefing on all the BMS functional objectives.

5.10 The system should be commissioned thoroughly to ensure that the BMS is installed and operating according to the functional objectives. Adequate resources should be allocated to the commissioning process to ensure that all aspects are covered.

Maintenance contracts

5.11 The safe and reliable operation of the BMS should be ensured by regular maintenance and performance checking. A maintenance schedule should be followed and records kept of all activities. Maintenance work should be undertaken by experienced and competent persons. Should NHS staff not be suitably qualified the maintenance contract should be sub-let. It is essential that a quality contractor is appointed because of the important nature of the building services controlled by the BMS. The maintenance sub-contractor should preferably be an approved partner to a BMS organisation

5.12 Initial maintenance is particularly important. Responsibility for this can be focused effectively by including the initial 12 months' maintenance in the supply contract. If maintenance is to be provided by the supplier/installer, it will be advantageous to detail the costs in the initial tenders.

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> **Note:** 1.This approach should reduce the potential for disputes during the contract defects liability period;
>
> 2. Maintenance arrangements should commence at handover.

5.13 Third-party software for energy monitoring and targeting (M&T) and for planned preventive maintenance can run on the central station computer. Any faults and failures of the BMS can affect the performance of these software packages.

5.14 A BMS can control critical building services plant, so it is necessary that a high quality breakdown support service is available at all times. It is the responsibility of management to specify the required emergency and breakdown response. The contractor should be experienced, reliable and able to meet specified emergency response requirements.

5.15 Management is responsible for the appointment of a specialist contractor to provide a maintenance service and emergency breakdown support should NHS staff not be suitably qualified. A quality contractor is essential because of the important nature of the building services controlled by the BMS and therefore should preferably be an approved partner to a BMS organisation.

5.16 A strict quality assurance procedure should be enforced to ensure that documentation is continuously updated to record changes made to the BMS.

Training of personnel

5.17 Management should provide appropriate training for personnel responsible for the operation and maintenance of the BMS to enable them to undertake their designated tasks. Management should be aware that competent and enthusiastic BMS operators help to maximise the potential of a BMS operation. To prevent mishandling of the system, access to the BMS should be password-protected and limited to authorised users by a hierarchical procedure.

BMS ownership

5.18 It is a management responsibility to ensure that the standards applied during the design and installation of a BMS are not reduced during the operation and maintenance of the equipment.

5.19 Clear lines of managerial responsibility should be in place so that no doubt exists as to who is responsible for the correct operation and maintenance of the equipment. A periodic review of the management systems should take place in order to ensure that the agreed standards are being maintained.

5.20 It is essential that the concept of ownership of the BMS is cultivated to enable the user to realise the full potential of the system.

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BMS drawbacks

5.21 A BMS can either fail completely or not realise its full potential and benefits, often through causes other than the equipment itself.

5.22 Most common causes of failure include:

- imposing a BMS onto poor or unreliable plant;
- insufficient attention given at the pre-contract stage to the definition and understanding of system requirement;
- ambiguous lines of responsibility regarding the users of the system and cover arrangements for absence;
- inappropriate staff selection, for example staff who are computer-literate but lack plant knowledge;
- poor commissioning or subsequent maintenance;
- lack of facility for future expansion.

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6. Designated staff functions

6.1 Only trained and competent persons should be appointed by management to operate and maintain the BMS.

6.2 **Management**: the owner, occupier, employer, general manager, chief executive officer or other person who is accountable for the premises and is responsible for issuing or implementing a general policy statement under the Health and Safety at Work etc. (HSW) Act, 1974.

6.3 **Employer**: any person or body who:

- employs one or more individuals under a contract of employment or apprenticeship;
- provides training under the schemes to which the Health and Safety (Training for Employment) Regulations 1990 (SI 1990/1380) apply.

6.4 **Designated person (electrical)**: an individual who has overall authority and responsibility for the premises containing the electrical supply and distribution system and who has a duty under the HSW Act 1974 to prepare and issue a general policy statement on health and safety at work, including the organisation and arrangements for carrying out that policy. This person should not be the authorising engineer.

6.5 **Duty holder**: a person on whom the Electricity at Work Regulations 1989 imposes a duty in connection with safety.

6.6 **Authorising Engineer (Low Voltage)**: a chartered engineer or incorporated electrical engineer with appropriate experience and possessing the necessary degree of independence from local management who is appointed in writing by management to advise on and monitor the safety arrangements for the low voltage electrical supply and distribution systems of that organisation to ensure compliance with the Electricity at Work Regulations 1989, and to assess the suitability and appointment of candidates in writing to be authorised persons (see SHTM 06-02: "Electrical safety guidance for low voltage systems").

6.7 **Authorised Person (LV – electrical)**: an individual possessing adequate technical knowledge and having received appropriate training, appointed in writing by the Authorising Engineer (LV) to be responsible for the practical implementation and operation of management's safety policy and procedures on defined electrical systems (see SHTM 06-02).

6.8 **Competent Person (LV – electrical)**: an individual who, in the opinion of an Authorised Person, has sufficient technical knowledge and experience to prevent danger while carrying out work on defined electrical systems (see SHTM 06-02).

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6.9 **Commissioning Specialist (BMS)**: an individual or organisation authorised to carry out commissioning, validation and routine testing of a BMS.

6.10 **Maintenance Person (BMS)**: a member of the maintenance staff, BMS manufacturer or maintenance organisation employed by management to carry out maintenance duties on a BMS.

6.11 **BMS operator**: any authorised individual who operates a BMS.

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7. Definitions

Actuator: an electromechanical device that positions control devices (such as valves or dampers) in relation to a supplied control signal.

Alarm: the annunciation of an event that the system operator needs to be aware of.

Analogue: pertaining to data that consists of continuously variable quantities.

BACnet: BACnet is a communication protocol for building automation and control networks, suited for the management and automation levels, especially for HVAC, lighting control, life safety, security and fire alarm systems.

BAS – building automation system: synonymous with BMS.

BEMS – building and energy management system: synonymous with BMS.

BMS – building management system: a system comprising electronic equipment and software with the prime function of controlling and monitoring the operation of building services within a building, including heating, air-conditioning, lighting, and other energy-using areas.

BMS contractor: the organisation responsible for the supply and/or installation of the BMS. The contractor may be either the manufacturer or a systems house. It is often the case that the BMS contractor will commission the BMS.

Bus: a means of connecting a number of different devices, sensors, controllers, outstations, etc. to act as a means of data exchange.

Central station: the primary point of access to a BMS; the usual point from which all operations are supervised.

Client: the individual or group of individuals ultimately responsible for paying for and using the BMS.

Commissioning: the advancement of an installed system to working order to specified requirements.

Commissioning specialist: the individual responsible for the commissioning of the BMS. He/she may be employed by the BMS contractor or a specialist commissioning company.

Communications network: a system of linking together outstations and a central station to enable the exchange of data. Usually a dedicated cable system, but radio or mains-borne signalling may be used.

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Compensator: a control device whose control function is to either:

- reduce heat supply with decreasing building heat load; or
- reduce cooling energy supply with decreasing building cooling load, in response to outside and (sometimes) inside temperatures.

Completion: the state of being finished in its entirety, according to the specification, ready for use by the owner.

Configuration software: software (in the form of "building blocks") resident in an outstation which can be configured to create different control strategies.

Control function: a term used to describe a specific, discrete form of control, for example compensation, optimisation, etc. These can be linked together in a control strategy.

Control loop: proportional, or proportional + integral, or proportional + integral + derivative control strategy where the output is related to a function of the input signal.

Control strategy: a description of the engineered scheme to control a particular item of plant or perform a series of control functions.

Data: a representation of information or instruction in a formalised manner suitable for communication, interpretation, or processing by humans or computer.

Derivative control: a control algorithm in which the control output signal is proportional to the rate of change of the controlled variable.

Direct digital control (DDC): a term used to define products that are based on microprocessor control.

Distributed intelligence: a description of a system where data processing and control is carried out at outstations, not at a central point.

Duty cycling: a control function that rotates the use of items of plant so that each item undergoes equal usage.

EMS – energy management system: synonymous with BMS.

Field device: the controls that are placed in the field level, that is, switches, sensors, actuators, etc.

Gateway: software written to enable data to be exchanged between two different communications protocols.

Handover: the transfer of ownership of all or part of a building or system, usually to the client.

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Integral control: a control algorithm in which the output signal is proportional to the integral of the error.

Load cycling: a control method where management of plant energy demand is achieved by means of fixed on/off periods of operation.

Load shedding: the function of switching off electrical equipment if the load exceeds a limit. This function therefore reduces the risk of maximum demand penalty charges.

LonWorks: Collective term for LON technology as a whole.

M-Bus - (Meter-Bus): Standardised field bus system (conforming to EN 1434) for the transmission of energy consumption data.

Modbus: Open standard protocol for industrial use.

OPC: Software interface defined in process automation.

Optimiser: a control device whose function is to vary the daily on and off times of heating, ventilation and air-conditioning (HVAC) plant in order to produce an acceptable environment with lowest energy usage.

Outstation: a device to which sensors and actuators are connected, capable of controlling and monitoring building services functions. It also has the facility to exchange information throughout the BMS network.

Performance tests: tests carried out to demonstrate that the system functions according to specification.

Point: a physical source or destination for data in the form of analogue or digital signals.

Pre-commissioning checks: systematic checking of a completed installation to establish its suitability for commissioning.

Proportional control: a control algorithm in which the output signal is proportional to the error in the controlled variable.

Proportional and integral control: a control algorithm in which the output signal is proportional to the error plus the integral of the error in the controlled variable.

Proportional and integral and derivative control: a control algorithm in which the output signal is proportional to the error plus the integral of the error and the rate of change of the controlled variable.

Protocol: a set of rules governing information flow in a communication system.

Sensor: a hardware device which measures, and provides to a control strategy, a value representing a physical quantity (for example temperature, pressure etc.); or activates a switch to indicate that a preset value has been reached.

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Soft point: a point that can be referenced as if it were a monitoring or control point in a BMS, although it has no associated physical location. It may have a set value or be the result of a given calculation or algorithm.

Stand-alone control: during normal operation, an item of equipment which can operate normally when isolated from the remainder of the system.

TCP/IP: Transmission Control Protocol/Internet Protocol

Testing: the evaluation of the performance of a commissioned installation tested against the specification.

Witnessing: the observation (by the client or his/her representative) of tests and checks of BMS hardware and operation prior to completion.

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