

BEMS (BUILDING ENERGY MANAGEMENT SYSTEMS) CONTROLS ENGINEER

Reference Number: ST0629

Details of standard

This apprenticeship standard is currently in development and its contents are subject to change

This occupation is found in the building services sector. Building Energy Management Systems are implemented in buildings with mechanical, HVAC (heating, ventilation and air conditioning) and electrical systems to enable energy efficient control of the internal environment. The buildings themselves can vary widely in size and function.

The broad purpose of the occupation is clearly focused upon the control, performance and efficiency of energy usage and comfort control in industrial/ commercial /public buildings of a diverse nature. It requires an associated understanding of these environments and the balance between cost, comfort, safety, health and wellbeing. It includes the specialist design, installation and commissioning expertise required to undertake this control and servicing function.

Typically a BEMS Controls Engineer will be involved initially with designing the building energy management system that controls the building services (eg heating, air conditioning, renewables). They may also write related software and graphics as well as installing and commissioning such systems. Another key area is connecting and integrating with other building systems (eg security) to create 'Smart Buildings'. After the building is occupied and being used they may also be involved in servicing & maintenance, fault finding if there are problems with the system and energy performance reviews.

Within the role the following skill set will be needed to cater for the range of different BEMS types:

1) Controls Hardware and Logic: Engineers will be required to select, install, configure and update control hardware platforms from the main manufacturers in the UK Market.

As well as manufacturer specific control hardware, engineers will also require generic knowledge. Particularly important is an understanding of controls principles such as logic, proportional and integral control and energy saving techniques for control strategy efficiency.

2) Field Devices: Field devices are manufactured by numerous organisations but can be, broadly speaking, categorised into Sensors, Valves, Actuators, Dampers, Variable Speed Drives, Switches and relays. The engineers will understand the controls and performance of field device types from first principles.

3) Networking: Standard network architectures such as TCP/IP, MSTP and RS485 are the mainstays of the industry so engineers will be required to design, install, maintain and fault find these types of networks along with more specialist sub-networks for integration of items like utility meters.

4) Communication Protocols: The engineers will be trained to a high level in the common open standard protocols in widespread use within the BEMS industry with the most common being BACNet.

5) Supervisor Software: Interaction with a BEMS is typically conducted via a 'software supervisor'. This is, generically, a graphics based software platform aimed at providing an intuitive way for the user to find their way around their system. The engineers will be required to have a knowledge of the construction of graphics, creation of user accounts, alarm management and schedule management.

Mainstream environments/considerations for the use of these skill sets include:

- Office buildings/Leisure centres/student accommodation/college campuses - with consideration for comfort and energy efficiency
- Hospitals/health care – specific clinical control requirements
- Historic buildings - internal building fabric/external building integrity
- Theatres – audience comfort/performance special effects
- Transport/entertainment hubs - high volumes of people in relatively short periods of time

In their daily work, an employee in this occupation interacts with a wide range of building stakeholders (eg owners/operators/facilities management/occupiers) in both the private and public sector. They would need to successfully liaise with both external and internal functions of their own organisation but also those of clients/key influencers (eg contractors/local councils/consultants) to ensure that different stakeholder needs are taken account of within the client's controls specification.

Employees will be both office and site based.

An employee in this occupation will be responsible for the delivery and performance of the BEMS and to achieve this they will have to manage budgets and teams of people, which

could vary depending on the size of the business. The BEMS industry is made up of a wide range of organisation types/sizes but there are a significant number of SME's (small/medium enterprises). Therefore employees will need to be able to work alone and under supervision.

Occupation duties

Duty	Criteria for measuring performance	KSBs
Duty 1 Design and create BEMS Technical Documentation	C1 - Compliance with Specification	K1, K2, K3, K4, K5, K6, K7, K8, K9, K15, K19
	C2 - Attention to detail	S1, S2, S3, S4, S18
	C3 - Adherence to Health & Safety legislation	B4, B6
	C5 - Adherence to industry produced guidelines and best practices	
Duty 2 Create wiring schedule and power loadings for panel manufacture	C1	K2, K7, K15, K17
	C2	S1, S5
	C3	B4
	C5	
Duty 3 Adhere to safe working practices to ensure the BEMS elements of the electrical systems are safe to use	C3	K2, K8, K16
	C4 - Adherence to current electrical regulations	S7, S8
	C5	B1, B3
Duty 4 Create Health & Safety documentation such as Risk Assessments and Method Statements (RAMS)	C1	K2, K10, K11, K16
	C2	S7, S8
	C3	B1, B3
	C4	
	C5	

Duty 5 Design and write software for control systems to an industry approved standard	C1	K2, K5, K7, K8, K15
	C2	
	C3	S1, S6
	C4	
	C5	B6, B12
Duty 6 Design and create client approved user interface for plant and systems with appropriate reference to integration issues	C2	K2, K3, K8, K9
		S1, S9
		B4, B6
Duty 7 Review completed control panel drawings to check, amend and approve	C1	K1, K2, K7, K8, K10, K15
	C2	
	C3	S1, S5
	C4	
	C5	B4, B5
Duty 8 Install BEMS control equipment and wiring systems	C3	K7, K10, K15, K16, K17
	C4	
	C5	S1, S7, S8, S9, S10, S11, S18
		B1, B2, B3, B4, B5, B6, B7, B8, B9, B11
Duty 9 Commission BEMS software and controls equipment	C1	K2, K3, K4, K5, K6, K7, K8, K9, K10, K11, K13, K15, K16
	C2	
	C3	
	C4	S1, S2, S3, S4, S5, S6, S7, S8, S9, S12, S18
	C5	
		B1, B2, B3, B4, B5, B6, B7, B8, B9, B11

Duty 10 Undertake a servicing and maintenance requirement of an existing BEMS installation	C3	K2, K6, K7, K8, K12, K15
	C4	
	C5	S1, S5, S7, S8, S9, S19
Duty 11 Carry out fault finding and rectification of defective control equipment or software algorithms	C2	B1, B3, B4, B5, B6, B7, B9, B11
	C3	K2, K7, K12, K15
	C4	S1, S6, S7, S8, S9, S11, S12, S13
	C5	B1, B2, B3, B4, B5, B6, B7, B8, B9, B11
Duty 12 Carry out and produce detailed conditional site survey reports along with remedial/enhancement recommendations	C2	K2, K3, K5, K8
	C5	
		S1, S2, S3, S4, S5, S6, S7, S8, S9, S12, S14
Duty 13 Produce recommendations for enhancing energy performance	C2	B1, B2, B3, B4, B5, B8, B9, B10, B12
	C5	K2, K3, K5, K8, K13
		S1, S9, S15
Duty 14 Carry out the electrical testing and inspection of BEMS related controls equipment	C2	B1, B2, B3, B4, B5, B8, B9, B10, B12
	C3	K14, K16, K18

	C4	S1, S7, S8, S9, S11, S16, S17
		B3, B4, B5, B7, B9
Duty 15 Create Operation and Maintenance documentation	C1	K1, K2, K7, K8
	C2	S1, S9
	C3	B4, B6
	C4	
	C5	

KSBs

Knowledge

K1 Understanding building control technologies and theory including:

- The primary role and function of the control system
- The merits of automated control over manual control methods
- The development of interface protocols so data can be shared and exchanged between the BEMS and 3rd party systems e.g. access systems and lighting systems

K2 Understand the fundamentals of controlling HVAC (heating, ventilation and air conditioning) and building technology

K3 Understand hydrodynamics and hydronic systems in buildings e.g. the transfer of heat energy and cooling energy through a building using water

K4 Understand thermodynamic relationships in air conditioning systems

K5 Understand cooling systems, heat generation and renewable technology

K6 Understand the principles and practices of measurement technology

K7 Understand Control Panel wiring, construction and relay logic

K8 Understand the control principles associated with the design, function, facilities management and use of the building

K9 Understand communications technology protocols and media

K10 Understand the practices and procedures for the installation of BEMS wiring systems

- K11** Understand the principles and practices for the commissioning of BEMS and associated equipment in buildings
- K12** Understand the principles for diagnosing and correcting faults in BEMS network systems and BEMS equipment in buildings
- K13** Understand the energy efficiency and comfort control requirement within buildings
- K14** Understand the testing, inspection and certification of BEMS related controls equipment
- K15** Understand the operation and application of BEMS field devices e.g. sensors
- K16** Understand relevant health & safety legislation and safe working practices applying to themselves and others. Give particular reference to understanding the requirements for protection of and safe working with electrical installations and BEMS impact on 'wellbeing'
- K17** Understand the general characteristics of electrical installations and how to assess them
- K18** Understand the requirements of inspection and testing of BEMS element of electrical installations
- K19** Understand the principles of control logic including the fundamentals of proportional and integral control

Skills

- S1** Applying the control principles associated with the design, function and use of buildings eg to create points lists, description of operation, cable schedules
- S2** Incorporating hydrodynamics/ hydronic systems into designs
- S3** Applying the principles and practices of measurement technology
- S4** Incorporating cooling systems, heat generation and renewable technology into designs as applicable
- S5** Incorporating Control Panel wiring, construction and relay logic into the design process
- S6** Applying communications technology protocols and media e.g. MODBUS and BACNET
- S7** Applying relevant safety legislation, codes of practice and safe working practices to themselves and others
- S8** Identifying requirements for protection of electrical installations
- S9** Incorporating the needs of a variety of building stakeholders (eg owners/ operators) within the design of the BEMS system

- S10** Applying the practices and procedures for the installation of BEMS wiring systems
- S11** Interpreting the requirements for the BEMS element of electrical installations
- S12** Applying the principles and practices for the commissioning of BEMS systems and equipment in a variety of building types and environments
- S13** Applying the principles, for diagnosing and correcting faults in BEMS network systems and BEMS equipment
- S14** Applying the principles for completing conditional site surveys, along with associated recommendations
- S15** Applying knowledge of energy efficiency to optimise comfort in buildings whilst minimising energy usage
- S16** Identifying the requirements of inspection and testing of BEMS element of electrical installations within relevant legislative requirements, specifications, codes of practice and industry recognised practices
- S17** Carrying out the testing, inspection and certification of BEMS related controls and equipment
- S18** Applying the principles and practices for the design and commissioning of standard network architectures. Eg Ethernet TCP/IP, MSTP and RS485
- S19** Carrying out updates to BEMS system hardware to ensure compatibility with latest products.

Behaviours

- B1** Be aware of the needs and concerns of others, especially in relation to diversity and equality
- B2** Create maintain, and enhance productive working relationships
- B3** Commit to compliance with health and safety
- B4** Strive to communicate effectively with work colleagues and clients using oral, written and electronic methods to communicate technical and other information.
- B5** Take responsibility for working independently and completing work to the appropriate specifications and codes of practice
- B6** Solving problems within their own scope of responsibility, by applying technical and behavioural skills and knowledge to define the problem, identify, evaluate and select alternatives and implement solutions.
- B7** Accepting responsibility for their own work and actions and that of others in their team

B8 Accepting, prioritizing, delegating and undertaking technical and other tasks effectively

B9 Committed to working effectively with colleagues, the public, clients and other stakeholders

B10 Take responsibility for personal development, demonstrating commitment to learning and self-improvement

B11 Exercise responsibilities in an ethical manner

B12 Undertake work in a way that contributes to sustainable development.

Qualifications

English and Maths qualifications

Apprentices without level 2 English and maths will need to achieve this level prior to taking the End-Point Assessment. For those with an education, health and care plan or a legacy statement, the apprenticeship's English and maths minimum requirement is Entry Level 3. A British Sign Language (BSL) qualification is an alternative to the English qualification for those whose primary language is BSL.

Additional details

Occupational Level: 4

Duration (months): 36

Review

This standard will be reviewed after three years.

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