

# Unit 13: Install and Commission Electrical and Electronic Services

Unit code:	L/504/4361
QCF level:	6
Credit value:	15

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## Aim

This unit enables learners to understand the transformation from an electrical services design to a functioning installation, and gain skills to plan and execute the installation, commissioning and maintenance of electrical and electronic services.

## Unit abstract

This unit enables learners to explore production and project management techniques and consider how they can be used to plan, manage and optimise the installation of electrical and electronic services and the associated operational issues. Learners will develop practical understanding of the skills and methods required to plan and execute an electrical services installation.

Learners will also develop the skills to define the procedures for commissioning and maintenance, and the development of the relevant documentation for these activities. Learners will consider the operational performance of the electrical services installation and investigate the use of strategies to promote energy efficiency.

## Learning outcomes

### On successful completion of this unit a learner will:

- 1 Understand the process of transformation from electrical and electronic designs to functional electrical services installations
- 2 Understand production techniques for electrical services installations
- 3 Be able to produce documentation for the installation and commissioning of electrical services
- 4 Be able to optimise the operating efficiency of electrical services installations.

## Unit content

### 1 Understand the process of transformation from electrical and electronic designs to functional electrical services installations

*Production processes:* earthing and bonding; lighting protection; utility sub-stations; main and sub-main distribution boards; final circuit distribution boards; cable containment systems; final circuit wiring; electrical supplies to mechanical and ancillary plant; lighting; lighting control; emergency lighting; small power installations; automatic fire detection and alarm systems; access control systems; intruder alarm systems, closed circuit television systems; voice and data wiring and distribution systems; IT equipment; telephone equipment; sustainable technologies (photovoltaic, wind generators, Combined Heat and Power, Micro-Combined Heat and Power); standby generators; Uninterruptible Power Supply systems; Build Management System; controls of mechanical and ancillary plant; monitoring equipment; temporary power and lighting

*Documentation:* design drawings; schematics; coordination drawings; design standards; mechanical design criteria; technical specifications; bills of quantity; site survey; working drawings; shop or fabrication drawings; installation drawings; manufacturers' drawings; builders' work drawings; detail drawings; record or as-built drawings; product literature; product selection; bills of materials; method statements; risk assessments; materials data sheets; project plans; estimation; material take-offs; environmental plans; environmental building strategy

*Method statements:* layout; accessibility; site management; coordination with other trades; installation methods; tooling requirements; skills requirements; task scheduling; materials deliveries; site storage; project management; teamwork; waste management; health and safety; risk assessment

*Builder's work:* equipment location; structural requirements; access for plant and equipment; service routes; penetrations for services; fire stopping; making good; marking out; sketch drawings; builder's work information; noise and vibration isolation; requirements for external works; requirements for weatherproofing

### 2 Understand production techniques for electrical services installations

*Production techniques:* productivity; work organisation; planning; production processes; operational management; on-site assembly; off-site assembly; number of production steps; cycle times; production flexibility; standardisation of components; standardisation of working methods; work methods; ergonomics; management structures

*Environmental impact:* energy demands; sustainability; waste generation; noise; vehicle emissions; machinery emissions; release of contaminants (air, ground or water); transportation; site access; lifecycle impacts; land use and ecology; electromagnetic compatibility (EMC); electromagnetic interference (EMI); radio frequency interference (RFI)

*Production method statements:* equipment installation parameters; innovation; technologies; prefabrication; accessibility; control systems; health and safety; tooling requirements; skills requirements; accessibility; site layout; testing; quality control; skills; jigs and special tooling; materials handling

*Legislation and approved codes of practice:* current legislation relevant to the home country; UK legislation to include the Health and Safety at Work etc Act (1974), the Construction (Design and Management) Regulations (2007), approved codes of practice and guidance notes, the Management of Health and Safety at Work Regulations (1999)

*Project installation programmes:* personnel management; time management; scheduling; critical path analysis; Microsoft Project; Gantt charts; health and safety; accessibility; site layout; testing; quality control; delivery schedules; interdependence between activities; manpower flexibility; resource management; forecasting; objectives

### 3 **Be able to produce documentation for the installation and commissioning of electrical services**

*Production documentation:* documentation stakeholders (owners, operating staff, occupants, users, maintenance staff, clients, consultants, process or facilities managers, design teams, contractors, commissioning team); functionality; general description (operating procedures, maintenance procedures, equipment and suppliers' schedules, manufacturers' literature, commissioning data, plans and drawings, building logbook, building user manual, identification of services); operation (recommended strategy for operation and control, outline of general operating mode, control data, procedures and sequences for start-up, running and shut-down, procedures for normal and emergency conditions, interlocks between plant equipment and control, operating procedures for stand-by plant, precautions against known hazards, target figures for energy consumption, connectivity with the Building Management System (BMS); Building Information Modelling (BIM)

*Test procedures:* materials and system testing; functional performance testing; checklists (materials, equipment and systems); test parameters; tolerances; consequence of rejection of failure to meet needs; inspection schedules; sampling procedures; quality control; witnessed testing; test documentation

*Commissioning plan:* commissioning checklists; commissioning quality requirements; acceptance procedures; take-over tests; construction phase; planning reviews; management of inspection delays; acceptance phase; performance testing; occupancy phase; start-up procedures; balancing procedures; parameter setting; measuring equipment; equipment calibration; commissioning personnel

*Environmental factors:* energy; fuel types; operational waste; noise; emissions; end-of-life disposal; low- or zero-carbon technologies; reduction of CO<sub>2</sub> emissions; electromagnetic compatibility (EMC)

*Maintenance requirements:* plant maintainability; warranty period requirements; isolation and return to service of plant and equipment; adjustment; calibration and testing; dismantling and reassembly; recommended spares; exchange of components and assemblies; safety precautions; preventative and corrective maintenance; manufacturer's recommendations; warranty procedures; special tools; test equipment; auxiliary services; nature of expected deterioration or defects; inspections; examinations; tests; lubrication; periodic overhaul; fault finding; disposal instructions

*Operation and control strategies:* training requirements; shut-down procedures; alarm procedures; operating procedures; logging procedures; plant and equipment index; operators documentation requirements; plant functionality; plant operability; plant safety planning; maintenance management strategy; security; backup procedures; maintenance scheduling; energy targets; centralised control; remote control; zoning; user interfaces; time-based controls; parameter optimisation controls

**4 Be able to optimise the operating efficiency of electrical services installations**

*Service energy performance data:* metering; sub-metering; monitoring; BMS; BIM; equipment set points; control strategies; base load; peak loading; part load operation; operating efficiencies

*Operational ratings:* energy performance certificates; display energy certificates; operational rating calculation; operational management; activity schedules; operating schedules; carbon emissions; fuel types; energy pricing; peak demands

*Environmental performance:* energy usage; carbon footprint; waste generation; emissions; noise; end-of-life disposal

*Strategies for monitoring and control:* objectives; utility consumption; parameter optimisation; performance criteria; performance monitoring; benchmarking; metering; sub-metering; data logging; data analysis; BMS; trend logs; centralised control; remote control; remote monitoring

## Learning outcomes and assessment criteria

<b>Learning outcomes</b> On successful completion of this unit a learner will:	<b>Assessment criteria for pass</b> The learner can:
LO1 Understand the process of transformation from electrical and electronic designs to functional electrical services installations	1.4 Evaluate the production processes based on a building service design concept 1.4 Prepare detailed drawings and installation documentation for the installation team 1.4 Devise the method statements based on project information 1.4 Analyse builder's work details for a specific design concept
LO2 Understand production techniques for electrical services installations	2.1 Evaluate the technical impact of production techniques based on layout drawings 2.2 Evaluate the environmental impact of the production technique for a specific design proposal 2.3 Prepare the production methods statements for an electrical installation project 2.4 Prepare a Health and Safety plan for an electrical installation project 2.5 Produce the project installation programme for the electrical and electronic services based on the contractor's programme of work
LO3 Be able to produce documentation for the installation and commissioning of electrical services	3.1 Produce the production documentation for a specific design proposal 3.2 Develop test procedures and measurable parameters for a specific building services installation 3.3 Produce a commissioning plan based on a design concept 3.4 Evaluate environmental factors based on the production and commissioning documentation for a project 3.5 Critically evaluate the maintenance requirements for an electrical installation 3.6 Evaluate operation and control strategies to ensure sustainable in use operation for a specific services project
LO4 Be able to optimise the operating efficiency of electrical services installations	4.1 Compare individual service energy performance data and operational ratings for a specific electrical services installation 4.2 Critically evaluate the environmental performance of an operating electrical services installation 4.3 Devise strategies for monitoring and control of the electrical services installation

## Guidance

### Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 4	Level 5	Level 6
Unit 10: Building Services Design, Installation and Maintenance in Construction (R/601/1260)	Unit 15: Production Management for Construction (L/601/1273)  Unit 47: Energy Utilisation and Efficiency for Building Services Engineering (F/601/1366)  Unit 57: Project Management for Building Services Engineering (T/601/1400)	Unit 14: Install and Commission Mechanical Services (Y/504/4363)

## Essential requirements

To prepare project documentation, learners will need access to design software such as AutoCAD or equivalent, as well as Microsoft Project or equivalent.

## Delivery

All the learning outcomes can be delivered flexibly. Formal teaching sessions should have input from the tutor to identify and emphasise the essential theoretical information. Learners are encouraged to undertake specific information searches individually, or as part of a team. Tutors should use real-life case studies for part of the assessment for this unit.

## Assessment

The learning outcomes for this unit are likely to be achieved through the analysis and evaluation of actual projects or case studies. This could be achieved through the preparation of drawings and written reports and/or presentations. Assessments should be focussed on the learner's individual development, but team work should also be considered as the installation and commissioning of electrical services is generally a team activity.

Learning outcome 1 could be assessed by transforming a specific design concept to a functional set of installation drawings, method statements, and builder work details.

Learning outcome 2 should focus on a written report which evaluates the technical and environmental impact of production techniques for a specific design proposal related to a project or case study. The learners should also prepare the related method statements and produce a project installation programme for this work.

Learning outcome 3 could be assessed by the preparation of the relevant documentation for the installation commissioning and maintenance of a specific electrical service or services. This should include an evaluation of the operation and control strategies to ensure sustainability and operational efficiency.

Learning outcome 4 should focus on the technical and environmental implications of managing and operating an electrical services installation. Learners should compare performance data and operational ratings for specific electrical installations. This could be based on a case study of a completed project, but learners should demonstrate that they can devise alternative strategies for monitoring and control of the electrical services installation.

## Resources

### Books

*Managing your Building Services KS02* (Chartered Institution of Building Services Engineers, 2005) ISBN 978-1903287552

Harker K – *Power System Commissioning and Maintenance Practice*, (IET, 1997) ISBN 978-0852969090

### Other publications

*BSRIA Technical Note 13/2002 Site Productivity – 2002 A Guide to the Uptake of Improvements*, Glenn Hawkins

*BSRIA Innovative M and E Installation Report*, David Wilson, ACT 9/200

CIBSE Commissioning Codes, 2003

CIBSE Guide M: *Maintenance Engineering and Management* (Chartered Institution of Building Services Engineers, 2008) ISBN 978-1903287934

CIBSE Guide K: *Electricity in Buildings* (Chartered Institution of Building Services Engineers, 2005) ISBN 978-1903287262

Institution of Engineering and Technology – *Requirements for Electrical Installations: IEE*

*Wiring Regulations*, 17th Edition (IET, 2008) ISBN 978-0863418440

### Website

[www.modbs.co.uk](http://www.modbs.co.uk)

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