



National Unit Specification: general information

UNIT Fundamental Electrical Systems (SCQF level 6)

CODE F5D8 12

SUMMARY

This Unit is designed for candidates with little or no prior knowledge of electrical systems but who wish to gain knowledge of such systems. Candidates may be school leavers or adults wishing to gain an insight into the fundamentals of electrical systems or wishing to pursue a course/career in electrical power engineering.

The aim of this Unit is to develop candidate's knowledge and understanding of electrical generation, transmission and distribution systems from the generating station to the point of control and protection within the consumer's installation.

On successful completion of this Unit candidates will be able to describe the operating principles and constructional features of High Voltage (HV) generators and the component parts of an electrical transmission system. They will also be able to describe both ring and radial distribution systems and the basic control and protection requirements of these systems. The methods of isolation, control, protection and earthing of Low Voltage (LV) electrical installations are also developed.

This Unit may form part of an NQGA or may be offered on a free-standing basis.

OUTCOMES

- 1 Describe the operating principles and constructional features of HV electrical generating and transmission systems.
- 2 Describe and draw HV electrical ring and radial distribution systems including the control and protection arrangements.
- 3 Describe the methods used in the isolation, control, protection and earthing of LV electrical installations.

Administrative Information

Superclass: XJ

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National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard grade Technological Studies — credit level
- ◆ Standard grade Physics — credit level
- ◆ Fundamental Electrical Systems at SCQF level 5

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Communication (SCQF level 6)
- ◆ Numeracy (SCQF level 6)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Describe the operating principles and constructional features of HV electrical generating and transmission systems.

Performance Criteria

- (a) Describe correctly the constructional features and operating principles of HV rotating electrical generators.
- (b) Describe correctly the constructional features and operating principles of HV transformers.
- (c) Describe correctly the requirements of HV transmission systems.
- (d) Describe correctly the features of HV transmission systems in terms of voltage levels throughout the system.

OUTCOME 2

Describe and draw HV Electrical ring and radial distribution systems including the control and protection arrangements.

Performance Criteria

- (a) Describe clearly the need for HV distribution systems.
- (b) Draw neatly, radial and ring HV distribution systems including control and protection components.
- (c) Describe correctly the control and protection requirements of radial and ring HV distribution systems.
- (d) Describe correctly the comparative features of radial and ring HV distribution systems.

OUTCOME 3

Describe the methods used in the isolation, control, protection and earthing of LV electrical installations.

Performance Criteria

- (a) Describe correctly the hazards associated with the utilisation of electrical energy.
- (b) Identify correctly the need for isolation, control, protection and earthing of LV electrical installations.
- (c) Describe correctly isolation, control and protection methods in LV Installations.
- (d) Identify correctly the types of earthing system used in LV installations in terms of the Wiring Regulations BS7671.
- (e) Describe correctly the requirements of earthing systems as outlined in BS7671.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria.

Candidate evidence should be generated under supervised, controlled open-book conditions.

Candidates should be permitted to use the Wiring Regulations BS7671 and other relevant documentation for reference during the assessment event.

Candidate evidence could be generated in the form of a single, holistic assignment report, produced at a single assessment event or a series of events, assessing individual or combinations of Outcomes. The total assessment time should be no more than two hours.

The assessment parameters are as follows:

With regard to Outcome 1:

- ◆ description of the main constructional features should be based on diagrams provided
- ◆ four requirements of HV transmission systems to be included

With regard to Outcome 2:

- ◆ two control and protection requirements to be included
- ◆ any two features from, open and closed operation of ring circuits, security of supply, circuit complexity, economic

With regard to Outcome 3:

- ◆ two hazards only to be described
- ◆ two features of each to be described
- ◆ earthing systems T-N-S, T-N-C, T-N-C-S, and T-T to be identified and described

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is an Award-specific Unit within the National Qualification Group Award in Electrical Engineering at SCQF level 6 but can also be taken on a free-standing basis.

The aim of this Unit is to develop candidate's knowledge and understanding of electrical generation, transmission and distribution systems from the generating station to the point of control and protection within the consumer's installation.

Candidates will be able to describe the operating principles and constructional features of HV generators and the component parts of an electrical transmission system. They will also be able to describe both ring and radial distribution systems and the basic control and protection requirements of these. The need for isolation, control, protection and earthing of LV electrical installations should also be discussed.

The content and context of this Unit should provide candidates with an overview of the electrical generation, transmission, distribution, isolation, control and protection, from the generating station to the installation within a consumer's premises and should consider the constructional and operational features of such systems. Earthing requirements within electrical installations should also be described in terms of BS7671.

The content should identify the component parts of the overall system and describe the purpose of each and its role within the system. Both HV and LV parts of the system should be identified and the voltage levels on each part of the system should be stated along with the reasons for these voltage values.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Although much of the content of this Unit is of a descriptive nature, it should be delivered in an environment which relates to the topic of electrical generation and distribution systems. This could be in a classroom or laboratory setting in which the environmental emphasis is placed on such electrical systems.

Delivery of the Unit content could utilize relevant industrial case studies, and drawings/layouts of practical systems. The use of relevant video's or DVD recordings showing transmission and distribution systems and equipment, and the requirements of electrical installations would also be appropriate.

The internet contains a rich source of information regarding the generation and transmission and distribution of electrical energy and candidates should be encouraged to use this facility.

National Unit Specification: support notes (cont)

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Opportunities should be provided to allow candidates to visit various premises to gain first-hand knowledge of electricity generating and plant and transformers and the distribution, isolation, control and protection equipment.

Candidates should be encouraged to discuss and debate the various issues raised by the subject content in order that this interaction might stimulate their thought processes and reinforce the learning.

The Outcomes should be delivered in the sequence given in the ‘statement of standards’.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates should be advised on the interpretation and production of complex written and oral communication to an acceptable industry standard. There are opportunities for accessing, analysing, summarising and evaluating a range of complex data to give background information on electrical systems, principles and installations. Knowledge and understanding of generation, transmission and distribution systems should be evidenced accurately and coherently, using appropriate graphic communication. Discussions during formative work could provide useful opportunities to enhance oral skills using vocational terminology in practical workshop environment.

Numeracy skills should be naturally enhanced as the Unit is undertaken, with the focus throughout on accuracy and the practical interpretation and conveying of numerical and graphical information. Formative activities should include materials designed to support candidates to master concepts confidently in practical electrical engineering contexts.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

The assessment of this Unit could take the form of an assignment in which evidence is produced through a candidate-generated report, covering the Performance Criteria specified in the Unit Outcomes ie:

- ◆ operating principles and constructional features of HV electrical generating and transmission systems
- ◆ control and protection requirements and the relative features of HV electrical ring and radial distribution systems
- ◆ isolation, control, protection and earthing of LV electrical installations

National Unit Specification: support notes (cont)

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Alternatively, three separate reports may be produced, one for each Outcome, to cover all of the Performance Criteria contained within the Outcomes. The combination of these separate reports may constitute an integrated report covering the complete Unit.

The report/s should be structured round a series of questions relating to the various Performance Criteria.

Each report would take no longer than 40 minutes to produce and the single, integrated report would be produced within a time limit of two hours.

Candidates should be allowed access to the Wiring Regulations BS7671, and other relevant documentation for reference purposes.

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).