



## National Unit Specification: general information

**UNIT** Electrical Power Systems (SCQF level 6)

**CODE** F5HJ 12

### SUMMARY

This Unit has been designed to introduce candidates to electrical power systems and provide opportunities to develop their knowledge and understanding of the National Grid System. Candidates will learn how electrical energy is generated from non-renewable and renewable energy sources. Candidates will conduct an investigation into the use of renewable sources of energy. In addition, candidates will study distribution feeder arrangements and the procedures required for working on high voltage equipment.

This Unit is designed for candidates who are seeking a career as an electrical or multi-disciplinary engineering maintenance technician in the power utility industry or large industrial complex.

This Unit may form part of A National Qualification Group Award or may be offered on a free-standing basis.

### OUTCOMES

- 1 Explain the main characteristics of the National Grid.
- 2 Explain sources of electrical power generation and measures to control consumer demand.
- 3 Explain distribution feeder arrangements for high voltage circuits.
- 4 Explain safe working practices as used on HV electrical transmission and distribution systems.

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#### Administrative Information

**Superclass:** XK

**Publication date:** March 2009

**Source:** Scottish Qualifications Authority

**Version:** 01

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## National Unit Specification: general information (cont)

**UNIT**      Electrical Power Systems (SCQF level 6)

### 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 Physics or Technological Studies — Credit Level
- ◆ NQ Unit *Fundamental Electrical Systems* (SCQF level 6)
- ◆ NQ Unit *Electrical Principles* (SCQF level 6)

### 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.

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

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

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

## **National Unit Specification: statement of standards**

### **UNIT       Electrical Power Systems (SCQF level 6)**

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**

Explain the main characteristics of the National Grid.

##### **Performance Criteria**

- (a) Explain clearly the concept of an idealised National Grid System and the practical variations from this model.
- (b) Interpret accurately a daily load demand chart relating to the National Grid System.
- (c) Explain clearly the Order of Merit system used in generation to meet the demand placed on the National Grid.
- (d) Explain correctly the function of power transformers in terms of stepping up and down voltages to transmit and distribute electrical power.
- (e) Interpret correctly a high voltage grid circuit from generation source to an individual customer.

#### **OUTCOME 2**

Explain sources of electrical power generation and measures to control consumer demand.

##### **Performance Criteria**

- (a) Explain clearly the terms non-renewable and renewable sources of electrical power generation.
- (b) Explain clearly the basic operation of non-renewable and renewable sources of electrical power generation.
- (c) Explain clearly the factors that determine the use of renewable energy sources.
- (d) Explain clearly measures to control consumer demand for electricity.

#### **OUTCOME 3**

Explain distribution feeder arrangements for high voltage circuits.

##### **Performance Criteria**

- (a) Interpret correctly a radial and a radial tee feeder arrangement.
- (b) Interpret correctly a parallel feeder arrangement.
- (c) Interpret correctly a ring system arrangement.
- (d) Explain clearly radial, radial tee, parallel and ring feeder arrangements in terms of continuity of supply, complexity and relative cost.

## **National Unit Specification: statement of standards (cont)**

### **UNIT       Electrical Power Systems (SCQF level 6)**

#### **OUTCOME 4**

Explain safe working practices as used on HV electrical transmission and distribution systems.

#### **Performance Criteria**

- (a) Explain correctly safe isolation procedures for HV plant.
- (b) Explain correctly the function of safety interlocks.
- (c) Explain clearly the testing-for-live procedures on HV plant as part of a safe working system.
- (d) Explain clearly the basic operation of earthing devices for HV plant as part of a safe working system.
- (e) Explain correctly a permit-to-work system for working on HV plant.

#### **EVIDENCE REQUIREMENTS FOR THIS UNIT**

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

#### **Outcomes 1, 3 and 4:**

Written and/or recorded oral evidence is required which demonstrates that the candidate has achieved Outcomes 1, 3 and 4 to the standards specified in the Outcomes and Performance Criteria. This evidence should be obtained under controlled, supervised conditions.

Outcomes 1, 3 and 4 may be assessed on an individual basis or as a single assessment covering all three Outcomes. The assessment for Outcomes 1, 3 and 4 should be no longer than 90 minutes and conducted under closed-book conditions.

#### **Outcomes 2:**

Written and/or recorded oral evidence is required which demonstrates that the candidate has achieved Outcome 2 to the standards specified in the Outcomes and Performance Criteria. This evidence should be obtained under controlled, supervised conditions.

Outcome 2 should be assessed by candidates undertaking an assignment in which they investigate non-renewable and renewable energy sources and measures to control electricity demand. Candidate evidence will be in the form of a written or oral report on their investigation. Written reports should be between 750 and 1,000 words excluding tables and diagrams. Oral reports should be supported by presentation evidence.

With regard to Outcome 1:

- ◆ the effects on system frequency and voltages under fluctuating load conditions to be explained correctly
- ◆ generation mix for base load and peak load demand to be explained correctly

## **National Unit Specification: statement of standards (cont)**

### **UNIT        Electrical Power Systems (SCQF level 6)**

With regard to Outcome 2:

- ◆ two non-renewable and three renewable and sources to be explained correctly
- ◆ three factors that determine the use of renewable energy to be explained correctly
- ◆ three measures to control the demand for electricity to be explained correctly

With regard to Outcome 4:

- ◆ one electrical and one mechanical interlock device to be explained correctly
- ◆ one integral and one temporary earthing device to be explained correctly

## **National Unit Specification: support notes**

### **UNIT        Electrical Power Systems (SCQF level 6)**

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 optional Unit within the National Qualification Group Award in Electrical Engineering at SCQF level 6 but may also be offered on a free-standing basis.

Successful completion of this Unit enhances the employability skills for candidates to gain employment in the power utility sector or an industrial employer with electrical power systems.

This Unit provides the opportunity for candidates to develop their knowledge and understanding of the National Grid System, sources of non-renewable and renewable power generation, distribution feeder arrangements and the safe working practices employed when working with high voltage transmission and distribution systems.

#### **GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT**

It is recommended that the Outcomes are delivered in the following order: Outcome 1, Outcome 2, Outcome 3, and Outcome 4. An organised visit to a generation, transmission and distribution control centre accompanied by a suitably electrically competent person would be beneficial to the candidates in achieving the Outcomes of this Unit. Visual examination of non-renewable and renewable power generation plant, transmission and distribution substations and the physical examination of component parts of high voltage cables, power transformers and switchgear are recommended.

It is also recommended that candidates conduct internet searches into appropriate websites relating to power generation and renewable energy sources including relevant legislation and regulations.

#### **OPPORTUNITIES FOR CORE SKILL DEVELOPMENT**

Candidates have to interpret and explain complex graphic information in charts, grid circuits and distribution feeder arrangements. Numeracy skills will be naturally enhanced, with a focus on practical applications. Formative activities should be designed to develop accuracy and confidence in handling graphic and numerical concepts in an electrical engineering context.

Although skills in Communication are not formally assessed candidates have to demonstrate detailed understanding of electrical power systems and safe working practices. Investigative work should involve analysing and evaluating up to date information on sources and applications of non-renewable and renewable power generation. Visits to a generation, transmission and distribution control centre would provide underpinning knowledge as well as opportunities to develop oral communication skills in a work related context. Written evidence produced should be accurate, clearly expressed and supported by appropriate graphics. Examples of renewable development applications and reports could be provided to indicate acceptable formats, structure and terminology.

## **National Unit Specification: support notes (cont)**

### **UNIT        Electrical Power Systems (SCQF level 6)**

#### **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)*.

Outcomes 1, 3, and 4 may be assessed on an individual basis or as a combination of Outcomes (eg Outcome 1 and 3 together and Outcome 4 separately) or as a single assessment covering all three Outcomes.

The assessment paper should comprise of a combination of short answer, restricted response and structured questions to allow candidates to display their knowledge of the National Grid System, distribution feeder types and their operational attributes and also HV safe working practices.

Outcome 2 should take the form of an assignment in which candidates investigate non-renewable and renewable energy sources and also the use of different types of renewable energy source. The assignment should also include measures to control consumer demand such as non-grid connected local micro generation, maximum demand management or energy efficiency measures.

Candidates will be expected to produce a written report on their investigation of between 750 and 1,000 words (excluding tables and diagrams) or an oral presentation supported by presentation evidence.

#### **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](http://www.sqa.org.uk)).