



National Unit specification: general information

Unit title: Domestic Hydro Generation Systems

Unit code: FF2T 12

Superclass: XK

Publication date: February 2011

Source: Scottish Qualifications Authority

Version: 01

Summary

This Unit is designed to provide candidates with knowledge and understanding on the provision of domestic hydro generation. The Unit will introduce candidates to the basic design principles, systems components and characteristics of domestic hydro generation systems. The Unit will also introduce candidates to fundamental health and safety and installation requirements for domestic hydro generation systems.

The Unit is suitable for candidates who are undertaking this study for the first time or wish to obtain a basic knowledge of domestic hydro generation. The Unit will allow for those currently employed in the building services industry to develop further knowledge specifically related to domestic hydro generation systems.

Outcomes

- 1 Describe the basic principles of domestic hydro generation systems
- 2 Describe the component parts and basic characteristics of domestic hydro generation systems
- 3 State the relevant Standards and Regulations used for the design, installation, commissioning and maintenance of domestic hydro generation systems

Recommended entry

Entry is at the discretion of the centre.

National Unit specification: General information (cont)

Unit title: Domestic Hydro Generation Systems

Credit points and level

1 National Unit 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

Opportunities to develop aspects of Core Skills are highlighted in the support notes of this Unit specification.

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

National Unit specification: statement of standards

Unit title: Domestic Hydro Generation Systems

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 basic principles of domestic hydro generation systems.

Performance Criteria

- (a) Describe clearly the basic terminology of domestic hydro generation systems.
- (b) Describe clearly the measurement of the main parameters of domestic hydro generation systems.
- (c) Solve accurately power and energy calculations for domestic hydro generation systems.
- (d) State clearly the main advantages of domestic hydro generation systems.
- (e) Describe clearly a typical site layout for a domestic hydro generation system.

Outcome 2

Describe the component parts and the basic characteristics of domestic hydro generation systems.

Performance Criteria

- (a) Show clearly by means of a diagram the location of the main component parts of a domestic hydro generation system.
- (b) Describe clearly the function of the main component parts of a domestic hydro generation system.
- (c) Describe accurately the types of turbine used in domestic hydro generation systems.
- (d) Describe clearly the electrical connection of domestic hydro generation systems.

Outcome 3

State the relevant Standards and Regulations used for the design, installation, commissioning and maintenance of domestic hydro generation systems.

Performance Criteria

- (a) State clearly the basic planning requirements and procedures in relation to the design and installation of domestic hydro generation systems
- (b) State clearly how Regulations apply to domestic hydro generation systems
- (c) State clearly how to minimise the risk to personnel and the environment when designing and installing domestic hydro generation systems.
- (d) State clearly the basic commissioning and maintenance requirements of domestic hydro generation systems.

National Unit specification: statement of standards

Unit title: Domestic Hydro Generation Systems

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. The evidence should be produced under 'open-book' supervised and controlled conditions.

Outcome 1

- (a) The candidate must correctly describe the basic terminology of domestic hydro generation systems. This description must include:
- ◆ Head
 - ◆ Flow
 - ◆ Power
 - ◆ Energy
- (b) The candidate must correctly describe the measurement of the main parameters of domestic hydro generation. This description must include:
- ◆ Measurement of Head
 - ◆ Measurement of Flow
- (c) The candidate must correctly solve power and energy equations for domestic hydro generation systems using the following formulae:
- ◆ $\text{Power} = \text{Head} \times \text{Flow} \times g \times \text{Efficiency}$
 - ◆ $\text{Energy} = \text{Power} \times \text{Capacity Factor} \times 8760$
- (d) The candidate must clearly state at least three advantages of domestic hydro generation systems. This description must include three of the following:
- ◆ high efficiency
 - ◆ high capacity factor
 - ◆ durability and reliability
 - ◆ cost effective
 - ◆ steady power output
 - ◆ maximum output power when needed in the winter
- (e) The candidate must correctly describe a typical site layout for a domestic hydro generation system. This description must include the following:
- ◆ Penstock layout

National Unit specification: statement of standards (cont)

Unit title: Domestic Hydro Generation Systems

Outcome 2

(a) The candidate must show by production of a diagram the location of the main component parts of a domestic hydro generation system. The diagram must indicate:

- ◆ Water intake
- ◆ Screening
- ◆ Penstock
- ◆ Turbine
- ◆ Tailrace

(b) The candidate must correctly describe the function of the main component parts of a domestic hydro generation system. This description must include:

- ◆ Water intake
- ◆ Screening
- ◆ Penstock
- ◆ Turbine
- ◆ Tailrace

(c) The candidate must correctly describe types of turbine used in domestic hydro generation systems. This description must include:

- ◆ Propeller
- ◆ Pelton Wheel
- ◆ Archimedes Screw

(d) The candidate must correctly describe the electrical connection of domestic hydro generation systems. This description must include:

- ◆ Off grid battery system
- ◆ Grid connected system

National Unit specification: statement of standards (cont)

Unit title: Domestic Hydro Generation Systems

Outcome 3

- (a) The candidate must correctly state the basic planning requirements and procedures in relation to the design and installation of domestic hydro generation systems. Design and installation factors must include:
- ◆ Siting and layout of installations
 - ◆ Matching turbine type to Head and Flow
 - ◆ Environmental Assessment
- (b) The candidate must state clearly how Regulations apply to domestic hydro generation systems. This must include the following:
- ◆ Controlled Activities Regulations
 - ◆ Electricity Supply Regulations
- (c) The candidate must clearly state the measures required to minimise risk to personnel and the environment when installing domestic hydro generation systems. This must include the following:
- ◆ Avoidance of pollution
 - ◆ Avoidance of obstruction of fish
 - ◆ Avoidance of electric shock
- (d) The candidate must clearly state the basic commissioning and maintenance requirements of a domestic hydro generation system and the importance of the following:
- ◆ Installation and commissioning checklists
 - ◆ Maintenance and servicing plans

National Unit specification: support notes

Unit title: Domestic Hydro Generation Systems

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

Outcome 1

Candidates must be able to demonstrate knowledge of the basic terminology used in domestic hydro generation systems specifically the terms Head, Flow, Power and Energy. Candidates must be able to demonstrate an understanding of the measurement of Head using basic survey techniques and the measurement of Flow using available data and physical measuring techniques.

Candidates must be able to demonstrate the solving of Power and Energy calculations for domestic hydro generation systems.

Candidates must be able to clearly state at least three advantages of domestic hydro generation systems from the following High Efficiency, High Capacity Factor, Durability and Reliability, Cost Effectiveness, Steady Power Output and Maximum Power Output during winter.

Candidates must be able to demonstrate knowledge and be able to describe a typical domestic hydro generation system layout in particular the Penstock only type.

Outcome 2

Candidates must be able to demonstrate knowledge of the location and function of the main component parts of a domestic hydro generation system. Components to be identified and located in a diagram are Water Intake, Screening, Penstock, Turbine and Tailrace. The candidates must also be able to describe the function of each of these components.

Candidates must be able to demonstrate knowledge of types of turbine namely Propeller, Pelton Wheel and the Archimedes Screw.

Candidates must be able to demonstrate knowledge and understanding of off grid and grid connected systems including the connection arrangements and the main components of these systems namely Battery Bank, Controller, Dump Load, Inverter, Isolation Breaker and Metering.

National Unit specification: support notes (cont)

Unit title: Domestic Hydro Generation Systems

Outcome 3

Candidates must be able to state the basic planning requirements and procedures for the design and installation of domestic hydro generation systems. Design and installation factors will include the siting and layout of installations, matching turbine type to site Head and Flow and a site environmental assessment.

Candidates must be able to state how the regulations apply to domestic hydro generation systems in particular the Controlled Activities Regulations and the Electricity Supply Regulations.

Candidates must also demonstrate awareness of the measures required to minimise risks when designing and installing domestic hydro generation systems. In particular, the following risks should be detailed and avoidance measures described: Avoidance of pollution, avoidance of obstruction of fish and the avoidance of electric shock.

Candidates will be able to demonstrate an understanding of the installation and maintenance of domestic hydro generation systems and the importance of installation and commissioning checklists and maintenance and servicing plans.

Guidance on learning and teaching approaches for this Unit

It is recommended that the Outcomes are delivered in the sequence presented in the Unit specification. The Unit may be delivered by a combination of lectures, tutorial work and practical laboratory work. The Unit should be taught very much in an electrical engineering/energy context and as such relevant engineering/energy examples should be used throughout Unit delivery.

While the majority of the Unit can be delivered in a classroom, centres should allow candidates to undertake practical experiments so that they have opportunities to relate theory learnt in the classroom to practice. For example, where domestic hydro generation equipment exists candidates should be allowed to carry out simple performance tests on these systems.

The Internet contains a rich source of materials on Renewable Energy and Domestic Hydro Generation Systems. Candidates should be aware of the different regulations, climates etc when using non UK based web sites.

The Unit should be fully supported with relevant learning materials (e.g. handouts in paper and electronic form, textbooks, on-line materials etc).

This Unit is not intended to endorse successful candidates as competent operatives of domestic hydro generation systems.

National Unit specification: support notes (cont)

Unit title: Domestic Hydro Generation Systems

Opportunities for developing Core Skills

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

Elements of *Numeracy* at SCQF level 5 may be developed in Outcome 1 where numerical skills are developed whilst carrying out power and energy calculations for domestic hydro generation systems. Using Graphical Information at SCQF level 5 may be developed in Outcome 1 where candidates are given graphical information to interpret and measure head and flow.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcome 1 where candidates may access and interpret information, research and select differing site layouts of domestic hydro generation systems.

The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcome 2 while candidates are interpreting drawings and diagrams of component parts of domestic hydro generation systems.

The Planning and Organising component of *Problem Solving* at SCQF level 5 may be developed as candidates undertake activities in Outcome 2 when candidates are developing engineering skills pertinent to a range of components used in domestic hydro generation systems.

The Planning and Organising component may also be developed in Outcome 3 where a candidate is developing basic planning procedures for domestic hydro generation systems. Elements of *Working with Others* Core Skill at SCQF level 4 may be developed in Outcome 3 while candidates are interpreting basic installation and commissioning procedures.

Although candidates do not have to demonstrate practical skills formative activities could enhance the skills of working with others. Candidates could be given constructive feedback to encourage review and evaluation of their approaches to practical work including their contribution to team working.

National Unit specification: support notes (cont)

Unit title: Domestic Hydro Generation Systems

Guidance on approaches to assessment for this Unit

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge and understanding of domestic hydro generation systems.

Summative assessment may take the following form:

Outcomes 1 and 2

Assessment may comprise of a single assessment paper covering the outcome and performance criteria requirements for both Outcomes. The assessment paper should be taken at a single assessment event lasting 1 hour and comprise of a suitable balance of short answer, restricted response or structured questions.

Outcome 3

Assessment may comprise of a single assessment paper covering the outcome and performance criteria requirements. The assessment paper should be taken at a single assessment event lasting 1 hour and comprise of a suitable balance of; multiple choice, short answer, restricted response or structured questions.

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)*.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

Version	Description of change	Date

© Scottish Qualifications Authority [2011]

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre, telephone 0845 279 1000.