SQA Advanced Unit Specification

General information for centres

Unit title: Renewable Energy Systems: Wave and Tidal Energy

Unit code: HV5P 48

Unit purpose: This unit has been designed to develop candidates' knowledge and understanding of renewable energy technologies and systems including their influence on meeting future energy needs and their environmental impact. This unit is part of a suite of SQA Advanced Units dedicated towards energy issues and in particular renewable energy solutions. Candidates will have opportunities to gain a knowledge and understanding of how wave and tidal energy can be harnessed to generate electricity for the national grid. Other issues relating to these emerging technologies are also considered.

On completion of the unit the candidate should be able to:

1 describe and analyse tidal power generation systems
2 describe and analyse wave power generation systems
3 evaluate and compare designs for extracting ocean energy

Credit points and level: 1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**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 National 1 to Doctorates.*

Recommended prior knowledge and skills: It is recommended that candidates have knowledge and understanding of energy and energy systems. This may be evidenced by possession of the SQA Advanced Unit HV48 47 *Renewable Energy Systems: Overview and Use* and the SQA Advanced Unit HV5N 48 *Renewable Energy Systems: Technology.*

Core skills: There are opportunities to develop the following core skill and core skill components in this unit, although there is no automatic certification of core skill or core skills components:

- Problem Solving SCQF level 6
- Communication SCQF level 6
- Information Technology SCQF level 6
- Numeracy SCQF level 6

Context for delivery: This unit has been developed as one of series of dedicated renewable energy units for a specialist optional section of the SQA Advanced Diploma in Engineering Systems. If this unit is delivered as part of another group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Assessment: The assessment strategy for this unit should be as follows:

Outcomes 1 and 2 should be assessed by a single assessment paper taken at a single assessment event lasting 1.5 hours. Assessment should be carried out under controlled, supervised, closed-book conditions.

Outcome 3 should be assessed by an investigation. Candidate evidence should be in the form of a report of 2,000 words in length plus diagrams and appendices. The investigation and report should be done in the candidates own time.

SQA Advanced Unit Specification: statement of standards

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The sections of the unit stating the outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe and analyse tidal power generation systems

Knowledge and/or skills

- Tidal motion and energy potential
- Tidal generating techniques and devices
- Power output generation
- Grid Integration
- Environmental implications of tidal power installations

Outcome 2

Describe and analyse wave power generation systems

Knowledge and/or skills

- Origins of ocean waves and their power
- Geographical and weather influences
- Devices and techniques used to extract energy from waves
- Power output from generation
- Grid integration
- Environmental implications of wave power installations

Evidence requirements

All Knowledge and/or Skills items in Outcomes 1 and 2 should be assessed.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to understand:

Outcome 1

- tidal motion and energy potential
  — spring and neap tides
  — amount and timing
  — tidal amplitude
  — tidal wavelength

- tidal generating techniques and devices
  — marine and stream currents
  — barrages and lagoons
  — mills
  — multiple basins

- power output generation
  — average power output
  — estimated energy supply

- grid integration
  — installation, commissioning and maintenance
  — cabling
  — substations and power smoothing
  — substation to grid

- environmental implications of tidal power installations
  — device survivability
  — topography
  — marine life
  — visual and physical barriers

Outcome 2

- origins of ocean waves and their power
  — local wind and wind sea
  — swell sea and remote storms
  — measuring and recording the expected height
    - surface
    - seabed
    - ship
  — height of the wave
  — significant wave height
  — zero Crossing Point
  — frequency or period
  — power formula

- geographical and weather influences
  — near shore
  — deep ocean
  — multiple wave components and duration
  — freak waves
  — underwater eruptions (tectonics)

- devices and techniques used to extract energy from waves
  - — passive and active wave power stations
  - — terminator
  - — attenuator
    - point absorber
  - — salter duck
  - — yemm sea-snake
  - — oscillating water column (OWC)
  - — raft
  - — buoy
  - — rectifier
  - — clam

- power output from generation
  - — average power output
  - — estimated energy supply

- grid integration
  - — installation, commissioning and maintenance
  - — cabling
  - — substations and power smoothing
  - — substation to grid

- environmental implications of wave power installations
  - — device survivability
  - — topography
  - — marine life
  - — visual and physical barriers

Outcomes 1 and 2 should be assessed by a single assessment paper taken at a single assessment event lasting one and a half hours. The test should be no more than 40 questions and there should be at least **one** question from each knowledge and/or skills item. Assessment should be carried out under controlled, supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

The assessment paper should be composed of appropriate balance of short-answer, restricted-response and structured questions.

Outcome 3

Evaluate and compare designs for extracting ocean energy

Knowledge and/or skills

- Geographical region suitability
- Design of devices
- Device construction
- Integrated system conceptual design
- Wave and tidal power generation strategy

Evidence requirements

All knowledge and/or skills items in Outcome 3 should be assessed.

Candidates will need to undertake an investigation and produce a report which covers the following subject areas:

- Introduction
- Geographical influences of channel / ocean terrain and mapping potential sites
- Power capacity, including issues of 'power on demand'
- Wave and tidal device modelling, design, construction, operation and reliability
- Proposal of an integrated conceptual design for tidal and wave power
- Roadmap of research and development for wind and tidal power
- Conclusions

The report should be 2,000 words in length plus diagrams and appendices. The investigation and report should be done in the candidates own time. Centres should make every reasonable effort to ensure the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Candidates should have access to course notes, relevant textbooks, papers, reports and the Internet while completing this report.

Assessment guidelines

Candidates must be encouraged to used appropriate software to produce the report and to prepare diagrams and drawings. Hand-written submissions should be discouraged. It may be necessary to provide some assistance with formatting and the selection of an appropriate style, and the candidate should be encouraged to include a title page and contents list to the document.

The candidate should be introduced to the concept of formal report writing and the necessity of logical development and clarity.

The difference between plagiarism and referencing the work of others should be made clear and a standard method of referencing should be specified.

As the assignment may include some research, it is important that candidates have access to the appropriate resources. It should be made clear that only credible internet sites should be referred to (and referenced).

Administrative information

Unit code: HV5P 48

Unit title: Renewable Energy Systems: Wave and Tidal Energy

Superclass category: XK

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History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

For further information, please call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit Specification: support notes

Unit title: Renewable Energy Systems: Wave and Tidal Energy

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 unit has been written as one of the 10 renewable energy units within the SQA Advanced Diploma in Engineering Systems. These are:

- Renewable Energy Systems: Overview of Energy Use (2 credits, SCQF level 7)
- Renewable Energy Systems: Technology (2 credits, SCQF level 8)
- Renewable Energy Store: Hydrogen (1 credit, SCQF level 8)
- Renewable Energy Systems: Wind Power (1 credit, SCQF level 8)
- Renewable Energy Systems: Solar (1 credit, SCQF level 8)
- Renewable Energy Systems: Biomass (1 credit, SCQF level 8)
- Renewable Energy Systems: Geothermal Energy (1 credit, SCQF level 8)
- Renewable Energy Systems: Hydroelectricity (1 credit, SCQF level 8)
- Renewable Energy Systems: Microgeneration Systems (1 credit, SCQF level 7)

The figures in brackets indicate the SQA Credit value and SCQF level of the unit respectively.

The double-credit unit, *Renewable Energy Systems: Overview of Energy Use* is a basic generic introduction to the subject and aims to present both a local and global perspective of energy use. *Renewable Energy Systems: Technology* describes the basic technology associated with renewable energy devices. The remaining units take a specialised look at each of the technologies currently believed to be significant, and there is the opportunity to specialise. It is important that all these units are seen as providing an integrated programme of study covering the energy issues with a focus on renewable energy systems. As such every opportunity should be sought to combine the delivery and assessment of any of these units.

In designing this unit, the unit writers have identified the range of topics expected to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each outcome. This has been done to help lecturers decide what depth of treatment should be given to the topics attached to each of the outcomes. While it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning.

The list of topics is as follows:

1 Describe and analyse tidal power generation systems (10 hours)

To give candidates the opportunity to learn and understand the principles of tidal power technology.

2 Describe and analyse wave power generation systems (10 hours)

To give candidates the opportunity to learn and understand the principles of wave power technology.

3 Evaluate and compare existing designs for extracting ocean energy (20 hours)

This outcome will involve investigation and research and is the main component of assessment. Candidates will be expected to draw conclusions which are based on this research.

The nature of this assessment will involve candidates in working on their own. It may, therefore, be prudent to set milestones for review where assessors can monitor the candidate's progress and provide feedback on a regular basis before the final submission of the report.

Guidance on the delivery and assessment of this unit

This unit may be delivered by a combination of lecturing, group work, investigation (including the use of the internet) and case studies. The internet contains a rich and varied range of materials relating to wave and tidal power.

Industrial visits may prove useful in allowing candidates to observe the manufacture and assembly of wave and tidal technologies. A tidal or wave generating farm may prove difficult to access while in operation. If this proves to be the case centres may use video or simulation systems. A number of manufacturers already provide this service on their websites.

Opportunities for developing core skills

All elements of the core skill of Problem Solving, that is, critical thinking, planning, organising, reviewing and evaluating, will be naturally developed and enhanced as candidates undertake the Investigation for Outcome 3. Identifying and considering all relevant factors, candidates analyse tidal and wave power generation systems, seeking solutions to a range of theoretical and practical problems associated with harnessing wave and tidal energy to generate electricity. Variables including costs, geographical and environmental issues are fully discussed. Designs for extracting ocean energy are identified, analysed and evaluated to present a comprehensive proposal of an integrated conceptual design for tidal and wave power.

Access to and evaluation of current research in wind and tidal power, using paper based and internet sources, will develop key skills in communication and information technology. Candidates should be provided with guidance on the style and structure of their Investigative report. They should be advised that technical accuracy of complex ideas and information should be supported by clearly annotated drawings and diagrams. Resources available could include appropriate software packages to support accuracy and the effective presentation of written and graphic information. Input from the assessor at various stages of report writing can provide opportunities for candidates to discuss issues, respond to questions and feedback and develop oral communication skills in a practical context.

A series of complex calculations and measurements underpins the findings and conclusions in the report. Numeracy skills will be naturally enhanced, with the focus on accuracy and the practical interpretation, application and presentation of complex numerical and graphical data. Formative practical activities should be designed to develop accuracy, flexibility and confidence in handling concepts in the context of renewable energy technologies and systems.

Open learning

This unit could be delivered by distance learning, which may incorporate some degree of on-line delivery and/or support. However, with regards to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence.

Arrangements would be required to be put in place to ensure that the combined assessment paper for Outcomes 1 and 2 is done under controlled, supervised conditions.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning (SQA 2000).*

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Renewable Energy Systems: Wave and Tidal Energy

This unit has been designed to allow you to develop knowledge and understanding of tidal and wave power generation and the technical difficulties associated with such technologies.

The unit commences with an examination of tides and a review of tidal devices and techniques for extracting energy. When such devices are operational and interfaced to the national grid they produce energy we can all use.

The unit goes onto explore wave power and wave devices and techniques for extracting energy. When such devices are operational they can also produce power for the grid.

The unit finishes with you examining the best geographical sites to locate wave and tidal installations. You will then investigate wave and tidal power device design and construction techniques with a view to finding the best design 'fits' for a geographical location in terms of reliability and survivability. You will come up with a conceptual design of how tidal and wave power and other technologies could be integrated and justified.

The formal assessments for this unit consist of a single assessment paper covering Outcomes 1 and 2 lasting one and a half hours and conducted under controlled, supervised conditions. You will not be allowed to take notes, textbooks etc into the assessment. For Outcome 3 you will be asked to undertake an investigation on wave and tidal power technology and produce a report of 2,000 words based on your investigation.