Higher National Unit specification

General information for centres

Unit title: Process Operations: Natural Gas Processing and Treatments

Unit code: F813 34

Unit purpose: The purpose of this Unit is to give candidates an in depth knowledge and understanding of the principles, processes and features of Natural Gas Production and Treatments.

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

1 Explain the principles and processes of natural gas production.
2 Evaluate the features and operating characteristics of gas compressors and associated ancillary processes and equipment
3 Explain the methods of gas dehydration and the removal of impurities
4 Explain the operation and control of natural gas processing

Credit points and level: 1HN credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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.*

Recommended prior knowledge and skills: Access to this Unit is at the discretion of the centre. However, candidates will find it beneficial to have some knowledge and understanding of the oil and gas process context in which this Unit appertains which may be evidenced by the possession of the following Unit:

F811 34: Petroleum Industry: Organisation, Products and Process

Core Skills: There are opportunities to develop the Core Skill of *Communication* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: This Unit was developed as an optional Unit within the context of the HNC/D award in Petroleum Process Technology, Operations and Control. 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: Outcomes 1, 2, 3 and 4 may be assessed together or individually. Assessment papers should be composed of a suitable balance of short answer, restricted response and/or structured questions. Assessment must be carried out under controlled, closed-book, supervised conditions.

Candidates must achieve all of the minimum evidence specified for each outcome in order to pass the Unit.

Higher National Unit specification: statement of standards

Unit title: Process Operations: Natural Gas Processing and Treatments

Unit code: F813 34

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

Explain the principles and processes of natural gas production

Knowledge and/or Skills

- Natural gas
- Processes and treatments
- Logistics

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain the principles and processes of natural gas production.

Evidence for the knowledge and/or skills items in Outcome 1 will be assessed through sampling. Candidates will be assessed on two of the three items in the knowledge and skills list. Assessment must be carried out under controlled, closed-book, supervised conditions.

Candidates will be required to provide evidence to demonstrate their Knowledge and/or Skills by showing they can:

- Explain the chemical and physical properties of natural gas, its basic raw form and the processed forms such as BGL, liquid petroleum gas (LPG) and liquefied natural gas (LNG).
- Explain processing and treatments of natural gas with reference to process system configuration and layout, compression, dehydration and the removal of impurities.
- Explain logistical aspects of natural gas production with reference to storage, metering and export, transport and distribution.

Assessment Guidelines

Outcome 1 may be assessed separately with a planned duration of approximately one hour or together with other Outcomes comprising this Unit. Assessments could be composed of a suitable balance of short answer, restricted response and structured questions. Assessment must be carried out under controlled, closed-book, supervised conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Outcome 2

Evaluate the features and operating characteristics of gas compressors and associated ancillary processes and equipment

Knowledge and/or Skills

- Compressor types — reciprocating, centrifugal, axial, staging, modern innovations and improvements
- Compressor operating characteristics — specifications, capacities, flow rates, pressure ratio, operating envelope, surge
- Ancillary processes — pigging, gas lift and fuel gas provision
- Ancillary equipment — instrumentation, drives, valves, drains

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can evaluate the features and operating characteristics of gas compressors and ancillary functions.

Evidence for this outcome will be provided on a sample basis with candidates being required to provide evidence for two of the four Knowledge and/or Skills items. Assessment must be carried out under controlled, closed-book, supervised conditions.

Candidates will be required to provide evidence to demonstrate their Knowledge and/or Skills by showing they can:

- Evaluate the types of compressors, their construction features, staging, functions of key components, and their principles of operation within a natural gas processing context.
- Evaluate the operating characteristics of compressors with respect to specifications including capacities, flow rates, pressure ratios, performance envelope and the phenomena of pulsation and surge.
- Explain gas production ancillary processes and features such as pigging, gas lift and the provision of fuel gas.
- Evaluate the role of ancillary equipment within a natural gas process system to include drives, valves, drains and instrumentation.

Assessment Guidelines

Outcome 2 may be assessed separately with a planned duration of approximately one hour or in conjunction with other Outcomes comprising this Unit. Assessments could be composed of a suitable balance of short answer, restricted response and structured questions. Assessment must be carried out under controlled, closed book, supervised conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Outcome 3

Explain the methods of gas dehydration and the removal of impurities

Knowledge and/or Skills

- Dehydration — problems associated with water in the gas stream, corrosion, slugging, gas stream export limits, dew point depression
- Dehydration methods — liquid desiccant, solid desiccant, molecular sieves, absorption, adsorption, filter coalescers, temperature separation, hydrate inhibitors, membrane dehydration
- Impurities — problems associated with impurities
- Methods of removal of impurities

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain the methods of gas dehydration and the removal of impurities.

Evidence for this outcome will be provided on a sample basis with candidates being required to provide evidence for three of the four Knowledge and/or Skills items. Assessment must be carried out under supervised conditions.

Candidates will be required to provide evidence to demonstrate their Knowledge and/or Skills by showing they can:

- Explain the problems and effects associated with water in the gas stream to include corrosion, slugging, gas stream export limits and dew point depression
- Explain the methods of dehydration to include liquid desiccant, solid desiccant, molecular sieves, absorption, adsorption, filter coalescing, temperature separation, hydrate inhibitors and membrane dehydration.
- Explain the problems associated with impurities in the gas stream such as CO2, H2S, COS, CS2 and mercaptans.
- Explain the methods of removal of CO2; acid gas; and other impurities such as COS, CS2 and mercaptans

Assessment Guidelines

Outcome 3 may be assessed separately with a planned duration of approximately one hour or in conjunction with other Outcomes comprising this Unit. Assessments could be composed of a suitable balance of short answer, restricted response and structured questions. Assessment must be carried out under controlled, closed book, supervised conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Outcome 4

Explain the operation and control of natural gas processing

Knowledge and/or Skills

- Operations — start-up, controlling, shutdown, pressurisation, purging, draining, likely problems encountered
- Control — operating conditions, operational requirements, compressor surge, condition monitoring
- Maintenance systems — inspection and routine maintenance, fault diagnosis, problem preventative measures
- Health, safety and environment (HSE) implications — safe working practices, Personal Protective Equipment (PPE), risk assessments, warning alarms, waste disposal

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain the operation and control of natural gas processing.

Evidence for this outcome will be provided on a sample basis with candidates being required to provide evidence for three of the four Knowledge and/or Skills items. Assessment must be carried out under controlled, closed-book, supervised conditions.

Candidates will be required to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- Explain the safe and effective operation of natural gas processing systems through the phases of start-up, continuous running and shutdown, and including aspects of pressurisation, purging, draining, and problems likely to be encountered.
- Explain the control, monitoring and adjustments of natural gas processing systems to meet operational requirements in terms of stable conditions, prevention/alleviation of problems such as compressor surge and other variances from system norms.
- Explain inspection, routine measures and fault diagnosis of natural gas processing systems together with problem preventative measures.
- Explain HSE implications of natural gas processing to include safe working practices, risk assessments, warnings, alarms, and disposal of waste.

Assessment Guidelines

Outcome 4 may be assessed separately with a planned duration of approximately one hour or in conjunction with other Outcomes comprising this Unit. Assessments could be composed of a suitable balance of short answer, restricted response and structured questions. Assessment must be carried out under controlled, closed-book, supervised conditions.

Administrative Information

Unit code: F813 34

Unit title: Process Operations: Natural Gas Processing and Treatments

Superclass category: YC

Original date of publication: August 2009

Version: 01

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 Higher National qualifications.

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

Higher National Unit specification: support notes

Unit title: Process Operations: Natural Gas Processing and Treatments

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 designed to contribute to the broad capacity building context of process operations within the petrochemical industries. It has specially been designed to provide knowledge, understanding and skills to support operations within the upstream and downstream sectors of the oil and gas industry in relation to natural gas processing, treatments, storage, export and distribution. The Unit is at SCQF level 7 and has been developed as part of the HNC/HND awards in Petroleum Process Technology, Operations and Control. In this context, the Unit has been designed to link to appropriate National Occupational Standards that form part of the suite of Scottish/National Vocational Qualifications (S/NVQs) in Process Operation: Hydrocarbons at Technician level. However this does not preclude the use of this Unit in other awards where it is appropriate and contributes relevance and added value to those awards. The Unit may also be delivered as a stand-alone Unit.

Access to this Unit is fully inclusive and at the discretion of the SQA approved delivery centre. However, candidates may find it beneficial to have a prior knowledge of this area as provided by the SQA HN Unit *F811 34: Petroleum Industry: Organisation, Products and Processes*.

This Unit has been written in order to allow candidates to develop knowledge, understanding and skills to allow candidates to achieve the following Outcomes:

1 Explain the principles and processes of natural gas production
2 Evaluate the features and operating characteristics of gas compressors
3 Explain the methods of gas dehydration and the removal of impurities.
4 Explain the operation and control of natural gas processing

A list of topics for each Outcome is given below:

Outcome 1

- Explain
  — chemical and physical properties of natural gas
  — basic raw form natural gas
  — processed forms as NGL, LPG and LNG
  — processing and treatments of natural gas
  — process system configuration and layout
  — compression
  — dehydration
  — removal of impurities
  — logistical aspects such as storage, metering and export, transport and distribution

Higher National Unit specification: support notes (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Outcome 2:

- Explain:
  - — types of compressors
  - — construction features, staging, functions of key components, and their principles of operation within a natural gas processing context
- Evaluate:
  - — operating characteristics of compressors including capacities, flow rates, pressure ratios
  - — performance envelope and the phenomena of pulsation and surge
  - — compressor drives
  - — valves and drains
  - — system instrumentation
  - — features such as pigging, gas lift and fuel gas

Outcome 3:

- Explain:
  - — the problems and effects associated with water in the gas stream such as corrosion, slugging, gas stream export limits and dew point depression
  - — methods of dehydration to include liquid desiccant, solid desiccant, molecular sieves, absorption, adsorption, filter coalescing, temperature separation, hydrate inhibitors and membrane dehydration
  - — problems associated with impurities in the gas stream such as CO2, H2S, COS, CS2 and mercaptans
  - — methods of removal of CO2; acid gas; and other impurities such as COS, CS2 and mercaptans

Outcome 4:

- Explain
  - — safe and effective operation of natural gas processing systems
  - — start-up, continuous running and shutdown
  - — system pressurisation, purging, draining and problems likely to be encountered
  - — system control, monitoring and adjustments
  - — maintenance of stable conditions
  - — prevention/alleviation of problems such as compressor surge and other variances from system norms
  - — inspection, routine measures and fault diagnosis
  - — problem preventative measures
  - — safe working practices
  - — risk assessments
  - — warnings and alarms
  - — disposal of waste

Higher National Unit specification: support notes (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Guidance on the delivery and assessment of this Unit

This Unit was developed as an optional Unit within the context of the HNC/HND award in Petroleum Process Technology, Operations and Control. It may be delivered as a stand-alone Unit or in appropriate context as part of another group award.

The content of the Outcomes of this Unit follows a logical delivery sequence.

This Unit may be delivered on a full-time, block release, open or blending learning, part-time day or part-time evening basis at the discretion of the SQA approved delivery centre. Learning and teaching methods may include a combination of lectures, tutorials, practical/laboratory assignments, computer-based simulations, case studies and industrial visits. Candidates should have access to examples of diagrams, schematic layouts and static displays of natural gas plant and equipment to support the explanation of the process operations, functions of main plant and equipment and their construction features. Access to suitable practical or simulation facilities for demonstration purposes would be beneficial.

The use of flexible learning through on-line materials and methodologies is encouraged wherever possible to supplement and support the learning that takes place in the delivery centre. It is also recommended that candidates are directed to undertake internet research where a rich amount of material can be found that is relevant to the content of this Unit to support their learning. Wherever appropriate, it is recommended that relevant practical learning activities are used to support the development of the knowledge and understanding requirements of this Unit. At every appropriate opportunity, it is recommended that the delivery of this Unit reflects on the health, safety and environment implications relevant to the content and context of this Unit.

Opportunities are available within this Unit to develop the transferable Core Skill of *Communication* although this is not separately certificated.

Formal assessment of this Unit should take the form of short answer, restricted response and structured questions. Assessments should require candidates to support their responses to question with suitable labelled process layout schematics and diagrams showing the construction features of plant and equipment. Laboratory work, simulation exercises and case studies could be used as formative assessments to enhance the learning experience of candidates.

Details on approaches to assessment are given under Evidence Requirements and Assessment guidelines under each Outcome in the Higher National Unit specification: Statement of Standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates. Where sampling of knowledge and skills items is used for assessment, the sampling should be selected to meet the specific needs of the candidate cohort within the context of their current employment or progression goals.

Details on approaches to assessment are given under Evidence Requirements and Assessment guidelines under each Outcome in the Higher National Unit specification: Statement of Standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates.

Higher National Unit specification: support notes (cont)

Unit title: Process Operations: Natural Gas Processing and Treatments

Opportunities for developing Core Skills

There may be opportunities to gather evidence toward the Core Skill of *Communication* at SCQF level 6 within this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. With regard to assessment, planning would be required of the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessments were conducted under controlled, supervised conditions. Agreement would have to be made to ensure that a single assessment for the end test is delivered in a supervised environment under controlled conditions.

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**

General information for candidates

Unit title: Process Operations: Natural Gas Processing and Treatments

This Unit has been designed to allow you to develop the knowledge, understanding and skills involved in the operation of natural gas processing and treatments which will contribute to your development within the petroleum industry as a process operations technician or a measurement and control technician. The vocational focus of this Unit combines the necessary blend of key petrochemical processing related technological principles with knowledge of their industrial process applications in a safety and environmentally critical context.

The Unit comprises the following broad outcomes:

1 Explain the principles and processes of natural gas production.
2 Evaluate the features and operating characteristics of gas compressors and ancillary processes and equipment.
3 Explain the methods of gas dehydration and the removal of impurities.
4 Explain the operation and control of natural gas processing.

These outcomes are linked to National Occupational Standard that form part of the suite of Scottish/National Vocational Qualifications (S/NVQs) in Process Operation: Hydrocarbons at Technician level.

Within this Unit, you will also have opportunities to develop the transferable Core Skill of *Communication* although this is not separately certificated.

Access to this Unit fully inclusive and at the discretion of your SQA approved delivery centre. However, you may find it beneficial to have a prior knowledge of this area as provided by the SQA HN Unit *F813 34: Petroleum Industry: Organisation, Products and Processes*.

This Unit can be delivered on a full-time, block release, open or blending learning, part-time day or part-time evening basis at the discretion of your SQA approved delivery centre. Learning and teaching methods may include lectures, tutorials, group work, practical/laboratory assignments, computer-based simulations and case studies. The use of flexible learning through on-line materials and methodologies may be used to supplement and support the learning that takes place in the delivery centre.

Formal assessment of this Unit may take of written test composed of a suitable balance of short answer, restricted response and structured questions. Assessments will normally be conducted at the end of the delivery of each Outcome. Where assessments are combined, these may be conducted toward the end of the Unit. Assessment will normally be carried out under controlled, closed-book, supervised conditions.