

GQA PAA\VQSET LEVEL 2

AWARD FOR NUCLEAR INDUSTRY AWARENESS

603/4978/5

Qualification Handbook

Knowledge-based Qualifications

AUGUST 2021 V1

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PAA\VQ-SET

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INTRODUCTION TO THE HANDBOOK

This qualification sits within the Regulated Qualifications Framework (RQF).

This Qualification Handbook has been developed to ensure that PAA\VQ-SET Centres understand the requirements of the qualification. The Handbook contains the following information:

- Qualification Structure
- Process of Assessment
- Glossary
- Qualification Units

This Qualification Handbook has been developed to provide support in the implementation of the qualification as well as giving information to ensure that the assessment and quality assurance is consistent, robust and reliable within each centre and nationally. The handbook also contains details of the skills and/or knowledge the learner must obtain to achieve the units and qualification.

Qualification Structure

This section of the handbook summarises the content of the qualification and the skills and/or knowledge learners that achieve it can be expected to gain. It also outlines the units required to achieve the qualification and will give the learner an idea of how long the qualification will take to achieve through the Total Qualification Time (TQT) and how much contact time they can expect through the Guided Learning Hours (GLH). It also provides information about possible progression opportunities once the qualification has been achieved.

Process of Assessment

The process of assessment outlines how the qualification will be assessed; this may be via an externally set examination, completion of a workbook or assignments, written or practical exercises, or a combination of these.

Qualification Units

The unit overview summarises the content of the unit and the skills and/or knowledge the learner will have gained on achievement of the unit. The units may also contain additional information in the assessment context which will describe the areas to be covered.

Qualification Assessment and Support Materials

Centres will be sent the following qualification assessment and support materials:

- Registration Spreadsheet
- Learner Guide
- Qualification Handbook

If the qualification is assessed by external examination and/or Internal Assessments, centres will also receive:

- Mock Examination and Answer Paper
- Internal Assessments and Scoring, if appropriate
- Internal Assessments Results Sheet, as appropriate

LEVEL 2 AWARD FOR NUCLEAR INDUSTRY AWARENESS

Qualification Summary

The Award has been primarily designed to meet the needs of apprentices and all other personnel new to the Nuclear Sector who need to gain a foundation level of understanding of the nuclear industry into which they will be starting their employment. The Award will also benefit those in the industry who wish to have a broader awareness and wish to gain recognition of their knowledge of the Nuclear Sector.

Total Qualification Time (TQT) and Guided Learning Hours (GLH)

Guided Learning Hours (GLH)

Guided Learning Hours are the time the learner is under the immediate supervision or guidance of a lecturer, supervisor, tutor or other appropriate provider or education or training.

The GLH for this qualification is 70

Total Qualification Time (TQT)

Total Qualification Time is comprised of 2 elements:

1. GLH
plus
2. an estimate of the number of hours a learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by (but not under the immediate supervision of) a lecturer, supervisor, tutor or other appropriate provider or education or training

The TQT for this qualification is 100

Achieving the Qualification

3 Mandatory Units must be achieved.

Mandatory Units

Unit No.	Unit Name
ANIA 1	History and Development of the Nuclear Industry
ANIA 2	Fundamentals of Nuclear Science
ANIA 3	Application of Nuclear Energy and Nuclear Waste Disposal

Progression

Information about related qualifications can be found on the GQA website www.GQAQualifications.com or on the Register of Regulated Qualifications website <http://register.ofqual.gov.uk>

Entry Requirements

This qualification requires learners to have a minimum GCSE standard of knowledge of the following subjects:

- Mathematics
- Science

PROCESS OF ASSESSMENT

The assessment of the Level 2 Award for Nuclear Industry Awareness will be via examination at a GQA approved examination centre and all learners must be registered with GQA for the qualification. GQA can provide a mock examination paper, and answer paper, to enable learners to prepare and revise for the external examination.

Examinations will be conducted in accordance with GQA's requirements to maintain national standards and rigorous quality assurance.

The questions have been developed by subject experts from the sector and directly relate to the unit requirements contained in this Qualification Handbook. To achieve the qualification learners must pass every unit in the external examination. Should a learner not pass all the required units from a qualification they will receive a unit certificate for the units they have achieved and will need to register to re-sit the failed units. Once all units have been achieved a certificate for the full qualification can be issued.

The Examination for the Level 2 Award for Nuclear Industry Awareness will be held at predefined dates as shown on GQA's Examination timetable. Subject experts provided by GQA will mark and moderate all examination papers returned by the Examination Centres and Centres will be notified of the results. The Examination will be graded as Pass, Merit or Distinction, as appropriate.

Centres will be externally verified by GQA to ensure that examinations and the centre have been conducted at the required standard.

Further information regarding GQA's requirements for Externally Examined Knowledge-based qualifications can be found in the Centre Portfolio.

Resources

Technical expertise

Staff delivering the technical certificate should have occupational expertise at the appropriate level, directly related to the qualification or equivalent qualifications at the appropriate level must be held.

GLOSSARY

Term	Definition
Access Arrangements	Arrangements that are approved in advance of an examination or assessment to allow achievement to be demonstrated by learners with a disability, special learning needs (including where the learner's first language is not English, Welsh or Irish) or to avoid unlawful discrimination
Appeal	The process through which an awarding organisation may be challenged on the outcome of an enquiry about results or, where appropriate, other procedural decisions affecting a centre or an individual learner
Assessment	The process of making judgements about the extent to which a learner's work meets the requirements of a unit, or any additional assessment requirements of a qualification
Assessor	A person who assesses a learner's work
Award of Qualifications	A certificate (electronic or paper-based) issued to an individual that recognises their achievement
Award	A qualification with a TQT value between 10 and 129
Awarding Organisation	A body recognised by the qualifications regulators to award qualifications
Centre	An organisation accountable to an awarding organisation for assessment arrangements leading to the award of qualifications
Centre Recognition	A process through which a centre wishing to offer an award or awards is confirmed as being able to maintain the required quality and consistency of assessment, and comply with other requirements of the awarding organisation
Certificate (1) for a Unit or Qualification	A record of attainment of a qualification issued by an awarding organisation
Certificate (2)	A qualification with a TQT value between 130 and 369
Credit	An award that may be made to a learner in recognition of the achievement of a unit or qualification
Credit Value	The number of credits that may be awarded to a learner for the successful achievement of a unit or qualification
Diploma	A qualification with a TQT value of 370 or above
Guided Learning Hours	The number of hours of teacher-supervised or directed study time required to teach a qualification or unit of a qualification
Learning Time	The amount of time a learner at the level of the unit is expected to take, on average, to complete the unit to the standard required

Term	Definition
Level	An indication of the relative demand, complexity and/or depth of achievement, and/or the autonomy of the learner in demonstrating that achievement
Mandatory Units	Units that must be achieved for the qualification to be awarded
National Occupational Standards (NOS)	Describe what a person needs to do, know and understand in a job to carry out the role in a consistent and competent way
Optional Unit	A unit that a learner may choose to complete to achieve the required number of units for award of the qualification
Pathway	A route to the achievement of a qualification that requires particular units to be achieved and is identified by an endorsement to a qualification title
Qualification	An award made to a Learner for the achievement of the required units or other components for that qualification
Qualification Level	An indication of the relative demand, complexity and/or depth of achievement, and/or the autonomy of the learner, represented by a qualification
Qualifications Regulators	Government-designated statutory organisations required to establish national standards for qualifications and secure consistent compliance with them
Recognition of Prior Learning (RPL)	A method of assessment that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and do not need to develop through a course of learning
Sector Skills Council	A body responsible for formulating and reviewing occupational standards for a specific sector across the UK, and for supporting the development of units and qualifications based on these standards. Each SSC is an employer-led, independent organisation and is licensed by government
Standardisation Of Assessment	A process to ensure that assessment leading to the award of qualifications is applied consistently by individuals, centres and awarding organisations
Unique Learner Number (ULN)	The unique number that is used to identify an individual learner
Unit	A component of a qualification

LEVEL 2 AWARD FOR NUCLEAR INDUSTRY AWARENESS

CONTENT OF THE QUALIFICATION

MANDATORY UNITS

UNIT ANIA 1	HISTORY AND DEVELOPMENT OF THE NUCLEAR INDUSTRY
LEVEL	2

Unit Overview

The aim of this unit is to provide an awareness of the history and development of the nuclear industry, security within nuclear sites, the UK nuclear stakeholders and behavioural expectations of employees. This will include:

- An outline of the history of the nuclear industry, looking at the military origins and the evolution of the civil nuclear programme within the UK energy mix.
- The primary purpose and operational phase of a range of UK nuclear sites and an international context.
- The role of the UK Inspectorates, including relevant acts and the powers of inspectors; Site Licence Conditions and the regulatory powers of the nuclear site licence.
- Security requirements and procedures with an overview of legislation.
- Behavioural and attitude expectations.
- General safety principles.
- The evolution of the public perception of the nuclear industry.
- Development of reactors in the nuclear industry

Information on use of Assessment Context

The following terms have a specific meaning in this unit:

History and evolution of the nuclear industry e.g.

- military origins of the industry, e.g. plutonium production
- Windscale Piles
- need to supplement energy supplies
- construction of power stations
- R&D facilities
- fuel fabrication
- reprocessing facilities
- enrichment facilities
- modern developments: fusion and SMRs
- decommissioning of nuclear facilities from end of use
- waste management, storage and disposal

The primary purpose and function of each main UK civil or military site

UK legislation relating to the nuclear industry e.g.

- Health and Safety at Work Act and its subsidiary regulations
- Nuclear Installations Act (NIA65/69)

- Ionising Radiation Regulations (IRR)
- Radiation Emergency Preparedness and Prior Information Regulations (REPPIR)

The purpose of Site Licence Conditions and the consequences of non-compliance.

Inspectorates and Regulators in the Nuclear Industry e.g.

- Role of the HSE and the ONR within it
- Environment Agency (including EA Wales and Scottish Environment Protection Agency Inspectors)
- Defence Nuclear Safety Regulator

Security requirements and procedures e.g.

- Security status
- Civil Nuclear Constabulary (CNC)
- General site security requirements

Behavioural and attitude expectations e.g.

- types of behaviour expected and prohibited on site
- regulations relating to behaviour and security, e.g. email and IT security, drink, drugs, driving on and off site

General radiological safety principles e.g.

- What is a safety culture and its importance to a nuclear site
- The principles of risk assessment and risk management
- Safe systems of work
- IRR
- ALARP
- COMAH

Public perception of the Nuclear Industry e.g.

- Supply chain and customers, e.g. government to private sector, confidential to open and transparent, supply chain support
- Incidents could be Chernobyl, Fukushima, 3 Mile Island

Relationship and management arrangements for contractors to include Site Licence Company, Tier1, Tier2, Tier3 etc.

Learning Outcome and Assessment Criteria

Learning outcomes The learner will:	Assessment criteria The learner can:
1. Be aware of the history and structure of the UK nuclear industry	1.1. Describe the history and structure of the nuclear industry in relation to the military origins of the industry and design developments 1.2. Describe the evolution of the civil nuclear programme in relation to the need to supplement energy supplies 1.3. List the location and operational phase of UK Nuclear Sites
2. Be aware of UK legislation for the nuclear industry	2.1. State how UK legislation relates to the nuclear industry
3. Be aware of Nuclear Site Licences, Inspectorates and regulators in the nuclear industry	3.1. Describe the requirements of Nuclear Site licences conditions and their purpose 3.2. State the consequences of a breach of the Site Licence 3.3. Identify the various Inspectorates and Regulators, their roles and powers 3.4. Describe the relationships and responsibilities under Nuclear Site Licences for Nuclear Site Licensees and their supply chain
4. Be aware of security requirements and procedures on a nuclear site	4.1. Describe the security requirements and procedures on a nuclear site in relation to relevant legislation
5. Know about Safety Culture and expected behaviours within the nuclear industry	5.1. Describe behaviour and attitude expected within the nuclear industry 5.2. Describe general safety principles such as a safety culture, risk assessment and risk management and other safe systems of work
6. Be aware of how the nuclear industry's public perception has evolved, and its place in the UK energy mix	6.1. State how the industry has changed in its relationships with its customers, supply chain and government 6.2. Describe how a particular incident has affected the nuclear industry and its perception by the public 6.3. State the different types of alternative energy sources which compete with the Nuclear industry available in the UK
7. Be aware of newer fusion and Small Modular Reactor (SMR) developments	7.1. List the fundamental differences in operation between current fission and in-development fusion reactors 7.2. List the advantages and disadvantages of Small Modular Reactors (SMRs) over conventional fission reactors

UNIT ANIA 2	FUNDAMENTALS OF NUCLEAR SCIENCE
LEVEL	2

Unit Overview

The aim of this unit is to provide a foundation in the scientific concepts and principles associated with atomic structure, radioactivity, ionising radiation, the detection of ionising radiation and its hazards.

- The fundamentals of atomic structure and the properties of the constituent particles.
- Definitions of chemical terms such as atomic mass, atomic number and isotopes. The types of radiation source and their properties; interaction with matter and application. Key nuclear terms. Ionisation and the interaction of radiation with matter.
- The methods of reducing and controlling radiation dose, specifically time, distance and shielding.
- The principles of monitoring instruments used to detect radiation including fixed, portable and personal devices.
- Control of contamination; the administrative and engineering controls used to control contamination and the use of PPE and contamination monitoring.
- The principles of nuclear fission, fusion and chain reactions.

Information on use of Assessment Context

The following terms have a specific meaning in this unit:

Structure of an atom e.g.

- Nucleus
- Shells
- Electrons
- Neutrons
- Protons

Radioactivity:

- Sources of background radiation, e.g. nuclear weapons testing, nuclear waste, cosmic rays, radon, potassium 40 in food and their classification as naturally occurring or synthetic
- Types of radiation, e.g. alpha, beta, gamma, neutrons, X rays
- Application of different types of radiation, penetration of radiation, range in air and skin
- Key terms within nuclear science e.g. Becquerel, Gray, Sievert, annual limit of intake, and half-life.

Interaction:

- Effects of radiation on human body e.g. short term - radiation sickness and long term - genetic mutation

Methods of reducing exposure to radiation, e.g. time, distance, shielding

Type of shielding required to protect against radiation, e.g. lead for gamma, aluminium or Perspex for beta, hydrogenous material for neutrons.

Control of contamination:

- Administrative controls e.g. classification of areas, local rules, training of personnel
- Engineering controls e.g. design of workplace, building materials, work surfaces, ventilation, barriers, glove boxes, PPE

General monitoring:

- Different detectors for different types of radiation
- Fixed Radiation Monitoring Systems, e.g.; ionisation chambers; portable (Geiger Mueller) and personal monitors (film badge).

Principles of nuclear fission, chain reactions, critical mass products produced by fission reactions e.g.

- fission products
- fission fragments
- energy neutrons
- transuranic elements
- neutron activated elements

Learning Outcome and Assessment Criteria

Learning outcomes The learner will:	Assessment criteria The learner can:
1. Be aware of the structure of an atom	1.1. Describe the structure of an atom 1.2. State the characteristics of electrons, neutrons and protons 1.3. List the mass number, atomic number and isotopes, isotopic abundance of uranium
2. Be aware of the nature and effect of radiation	2.1. Describe radioactivity in relation to its units of measurement 2.2. State personal limits of exposure in the human body and the effect of decay
3. Be aware of the methods of reducing exposure to radiation	3.1. State the methods of reducing exposure to radiation 3.2. List the type of shielding required to protect against radiation
4. Be aware of how contamination may be controlled	4.1. State how contamination may be controlled using administrative controls and engineering controls 4.2. State how contamination may be monitored 4.3. Describe the different types of equipment used for detection - fixed monitor; portable monitor and personal monitor
5. Be aware of the difference between fission chain reactions and fusion as related to the nuclear industry	5.1. State the principles of nuclear fission, chain reactions, critical mass products produced by fission reactions 5.2. Describe the basic atomic reaction which propagates fission reactions 5.3. Describe the basic methods of maintaining fission reactions under control 5.4. Describe the basic principles of fusion reaction and its method of safe control and propagation

UNIT ANIA 3

APPLICATION OF NUCLEAR ENERGY AND WASTE DISPOSAL

LEVEL

2

Unit Overview

The aim of this unit is to provide an understanding of the application of nuclear energy. It also covers the management of the waste generated along with emergency procedures. This will include:

- The processes involved in obtaining and refining reactor fuel for reactors.
- The management of the waste generated by both nuclear power stations and the nuclear industry.
- The construction and operation of a range of nuclear power stations and the hazards involved with operating a reactor.
- The concept of criticality and techniques to avoid it.
- Nuclear reactor and site emergency procedures.
- Where radioactive waste arises from, the possible hazards to the public and the environment and the different categories of waste, its treatment and disposal.
- The production and use of radioisotopes within the industry; and the commercial and military uses of radiation.
- Emergency procedures; the potential emergency situations which can occur on a nuclear site, the main types of indicators used to alert individuals on site, and what actions should be taken by the individual.
- The role of Environmental Agencies.

Information on use of Assessment Context

The following terms have a specific meaning in this unit:

Criticality and its avoidance e.g.

- mass
- density
- shape
- distance/geometry
- moderators
- reflectors

The components and functioning of nuclear reactor (including PWRs, ABWRs, EPRs and AGRs) and the secondary components associated with reactors that produce electricity or in nuclear propulsion plants.

- pressurising coolant
- using coolant and not air

Potential emergency situations which can occur on a nuclear site e.g. radioactivity, criticality, release of hazardous chemicals, explosion, fire.

Actions that should be taken by the individual e.g. shelter, respirators, increase the distance, reduce the time, exit the area.

Where radioactive waste arises from e.g.

- defence
- submarines
- nuclear fuel cycle
- nuclear power generation
- hospitals

- nuclear facility decommissioning

Possible hazards to the public resulting from the use of radioactive substances e.g.

- leaks
- transport accidents
- criticality
- possible effects on the environment

How the industry stores and treats the waste e.g.

- segregation
- burial
- cooled
- storage in ponds
- conditioning
- vitrification
- cementation

Uses of radioactivity in:

- Hospitals
- Weapons
- Radiation treatment
- Radiation used in checking thickness of manufactured products or in sterilisation
- Radiation sources in smoke detectors

Use of radioisotopes within industry e.g. medicine, food processing, smoke detectors, NDT in welding etc.

Learning Outcome and Assessment Criteria

Learning outcomes The learner will:	Assessment criteria The learner can:
1. Be aware of the different designs of nuclear fission reactors	1.1. Describe the basic nuclear fuel cycle from mining to waste and reprocessing 1.2. Describe criticality and how to avoid it 1.3. Identify the components and functioning of a fission nuclear reactor 1.4. List the principal reactor designs used in the UK
2. Know about emergency procedures in the nuclear industry	2.1. Describe the emergency procedures for potential emergency situations which can occur on a nuclear site 2.2. Give a general outline of the main types of indicators used to alert individuals on site and what actions should be taken by the individual 2.3. Describe the emergency levels used within the nuclear industry
3. Be aware of the procedures for dealing with radioactive discharges, waste, decommissioning and the environmental responsibilities of the nuclear industry	3.1. Describe where radioactive waste arises from 3.2. Explain the possible hazards to the public resulting from the use of radioactive substances 3.3. Describe how the nuclear industry categorises waste 3.4. Explain how the industry stores and treats the waste 3.5. State the role of the Environment Agencies
4. Be aware of different uses for radiation across commercial and military industries	4.1. Explain in general terms how fissile and fusion material is used in nuclear weapons 4.2. Explain how radioactive materials can be used within medical, manufacturing and home-based environments 4.3. Describe the production of radioisotopes in nuclear reactors and their use within industry