

# **RADIOACTIVE WASTE ADVISER SYLLABUS**

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## Introduction

This syllabus is based on the basic syllabus for the qualified expert in radiation protection with a few additional items from the “additional material” list as published in EC Communication 98/C133/03.

The syllabus is set out as follows:

The first column lists the topics given in the EC communication, with the addition of “Security of radioactive materials” which we felt warranted its own entry as this is a new topic since the EC syllabus was proposed.

The second column provides more detail, where appropriate, on what we expect to be included in the topic for a Radioactive Waste Adviser.

The third column gives the overall level of competence required and is based on a combination of knowledge and experience.

The competence required for each topic is based on three levels: General Awareness (GA), Basic Understanding (BU) and Detailed Understanding (DU). These levels are defined as:

**General Awareness:** knows that the topic exists and is aware of its significance to work activities in context. Also knows how and where to obtain help on the topic if needed.

**Basic Understanding:** has a basic understanding of the topic with a level of detail that allows the Radioactive Waste Adviser to apply it to familiar work activities in context. If necessary, the Radioactive Waste Adviser can research further knowledge using readily available sources and apply it in less familiar circumstances.

**Detailed Understanding:** has a good understanding of the topic and the underlying principles and can apply the knowledge in appropriate contexts. The Radioactive Waste Adviser can apply the knowledge working from basic principles to deal with situations in new or unfamiliar areas.

The fourth column shows whether experience of the topic needs to be demonstrated to achieve competence.

## **Simulation**

The environment agencies will encourage Assessing Bodies to use simulations and similar approaches in their assessment of candidates for the role of Radioactive Waste Adviser (RWA).

This is because we recognise that some applicants may have difficulty in obtaining practical experience in some areas of radiation protection and hence may wish to use simulation in place of, or to supplement, their workplace evidence.

Simulation involves the creation of a realistic workplace scenario incorporating relevant radiation protection issues that a Radioactive Waste Adviser would be expected to address. The applicant submits evidence to demonstrate the necessary practical competence to resolve those radiation protection issues.

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
1.	Basic atomic and nuclear physics	<ul style="list-style-type: none"> <li>• Atomic structure and composition of the nucleus</li> <li>• Stable and unstable isotopes, activity</li> <li>• Types of radioactive decay</li> <li>• Nuclear fission</li> <li>• Half life and decay constants</li> <li>• Radioactive equilibria</li> <li>• The effects of time, distance and shielding</li> </ul>	BU	No
2.	Basic biology	<ul style="list-style-type: none"> <li>• Basic radiation chemistry</li> <li>• Effects of radiation on cells and tissue</li> </ul>	BU	No
3.	Interaction of radiation with matter	<ul style="list-style-type: none"> <li>• Charged particles, photons and neutrons</li> <li>• Types of nuclear reactions</li> <li>• Induced radioactivity</li> </ul>	BU	No
4.	Biological effects of radiation	<ul style="list-style-type: none"> <li>• Deterministic biological effects of ionising radiation</li> <li>• Stochastic biological effects of ionising radiation</li> <li>• The dose–response relationship</li> <li>• Effects of whole body irradiation</li> <li>• Effects of partial body irradiation</li> </ul>	BU	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
5.	Detection and measurement methods (including uncertainties and limits of detection) for radioactive waste assessment and environmental monitoring	<ul style="list-style-type: none"> <li>Principles and theory of detection and measurement (e.g. efficiency, background, geometry, statistics)</li> <li>Types of detection instruments (e.g. gas filled, ionisation chambers, scintillators, thermoluminescence, neutron detectors)</li> <li>Choice of detection instruments</li> <li>Interpretation of instrument measurements</li> </ul>	BU	No
6.	Quantities and units (including dosimetry underlying regulatory quantities)	<ul style="list-style-type: none"> <li>Units</li> <li>Dose terms (absorbed dose, equivalent dose, effective dose, committed dose)</li> <li>Dose limits and constraints</li> <li>Dosimetric calculations</li> </ul>	BU	No
7.	Basis of radiation protection standards	<ul style="list-style-type: none"> <li>Linear hypothesis for stochastic effects</li> <li>Threshold for deterministic effects</li> <li>Epidemiological studies</li> </ul>	BU	No
8.	ICRP principles:	<ul style="list-style-type: none"> <li>Principles (justification, optimisation, limitation)</li> </ul>		
8a.	- Justification	<ul style="list-style-type: none"> <li>Justification of practices</li> </ul>	BU	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
8b.	- Optimisation	<ul style="list-style-type: none"> <li>Optimisation of protection from radioactive substances</li> </ul>	BU	No
8c.	- Dose limitation	<ul style="list-style-type: none"> <li>Dose limits</li> </ul>	BU	No
9.	Practices and interventions (including natural radiation sources)	<ul style="list-style-type: none"> <li>Practices and Interventions</li> </ul>	GA	No
10.	Legal and regulatory basis:			
10a.	- International recommendations/conventions	<ul style="list-style-type: none"> <li>Conceptual framework (ICRP basic framework, justification/optimisation/dose limits, system of protection for intervention)</li> <li>International organisations (IAEA, ICRP, ICRU, UNSCEAR, OECD)</li> </ul>	GA	No
10b.	- European Union legislation	<ul style="list-style-type: none"> <li>The EURATOM Basic Safety Standards Directive</li> <li>Council Regulation (EURATOM) 1493/93 The shipment of radioactive substances between Member States</li> </ul>	GA	No
10c.	- Key national legislation and	<ul style="list-style-type: none"> <li>Legislative framework in the UK</li> </ul>	DU	Yes

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
	regulations (including competent authorities)	<ul style="list-style-type: none"> <li>• UK Regulatory bodies and regulatory system</li> <li>• Knowledge of the main requirements of the following legislation and principles and guidance:               <ul style="list-style-type: none"> <li>○ The Environmental Permitting Regulations 2010 (EPR10)/The Radioactive Substances Act 1993 (RSA93)</li> <li>○ Exemption orders made under EPR10/RSA93</li> <li>○ Published policies and guidance from the environment agencies</li> <li>○ Limitations and conditions included in environment agencies' permits</li> </ul> </li> </ul>		
10d.	- National legislation and regulations affecting radioactive sources and radioactive waste	<ul style="list-style-type: none"> <li>• The HASS and Orphan Sources Regulations 2005</li> <li>• The Ionising Radiations Regulations 1999</li> <li>• Directions made under RWL</li> </ul>	BU	No
10e.	- Other relevant RS legislation	<ul style="list-style-type: none"> <li>• The Justification of Practices Involving Ionising Radiations Regulations 2004</li> </ul>	GA	No

Number	Topic	Content	Competence	
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		<ul style="list-style-type: none"> <li>The Radiation (Emergency Preparedness and Public Information) Regulations 2001</li> <li>The Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008</li> <li>Radioactive Contaminated Land legislation</li> </ul>		
10f.	- Other relevant waste legislation		GA	No
11.	Operational radiation protection:			
11a.	- Types of sources (sealed, unsealed sources, and accelerators excluding X-ray units)	<ul style="list-style-type: none"> <li>Types of sources – sealed and unsealed</li> <li>Sources of radioactivity – natural and man-made</li> <li>Uses of radioactive sources (e.g. medical, research, industrial radiography, irradiators and accelerators, gauges, radiotracers, well logging, radioisotope production, nuclear medicine, radiotherapy, nuclear installations, mining and processing of raw materials)</li> </ul>	BU	No



Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
11b.	- Hazard and risk assessment (including environmental impact)	<ul style="list-style-type: none"> <li>• Radiological impact assessment methods</li> <li>• Pathways by which radioactive discharges may lead to a public dose:               <ul style="list-style-type: none"> <li>○ External</li> <li>○ Airborne – direct ingestion</li> <li>○ Airborne – deposition, followed by ingestion via food pathway</li> <li>○ Airborne – inhalation</li> <li>○ Liquid – direct ingestion (drinking water)</li> <li>○ Liquid - ingestion via food pathway</li> <li>○ Contact</li> </ul> </li> <li>• Bio-accumulation effects</li> <li>• Impacts of radiation on non-human species</li> </ul>	DU	Yes
			BU	No
11c.	- Minimisation of risk	<ul style="list-style-type: none"> <li>• Containment and control of radioactive waste</li> </ul>	GA	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
11d.	- Control of releases  Quality and environmental management systems	<ul style="list-style-type: none"> <li>• Understanding of conditions and limitations in RWL Permits</li> <li>• Investigation requirements for radiological incidents</li> <li>• Understanding of operating instructions relevant to RWL permits</li> <li>• Understanding of maintenance instructions relevant to RWL permits</li> <li>• Understanding of emergency instructions relevant to RWL permits</li> <li>• Understanding the reporting requirements and systems for radioactive sources and discharges</li> </ul>	BU	Yes
	Abatement technology	<ul style="list-style-type: none"> <li>• Abatement technologies available</li> <li>• Maintenance needs of abatement technologies</li> </ul>	GA	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
11e.	<ul style="list-style-type: none"> <li>- Monitoring</li> <li>- Area monitoring</li> <li>- Personal dosimetry (external, real time and internal)</li> <li>- Biological monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Personal monitoring methods</li> <li>• Monitoring of operations – instrumentation and control methods</li> <li>• Knowledge of instrument calibration procedures</li> </ul>	GA	No
11f.	<ul style="list-style-type: none"> <li>- Critical group concept/dose calculation for critical group</li> </ul>	<ul style="list-style-type: none"> <li>• How to determine the collective dose</li> <li>• How to assess critical group dose</li> </ul>	BU	No
11g.	<ul style="list-style-type: none"> <li>- Ergonomics (e.g. user-friendly design and layout of instrumentation)</li> </ul>		GA	No
11h.	<ul style="list-style-type: none"> <li>- Operating rules and contingency planning</li> </ul>	<ul style="list-style-type: none"> <li>• Relevant aspects of work procedures written for radioactive waste management purposes including management procedures, work instructions, local rules etc.</li> </ul>	BU	No
11i.	<ul style="list-style-type: none"> <li>- Emergency procedures</li> </ul>	<ul style="list-style-type: none"> <li>• Relevant aspects of emergency response planning</li> </ul>	BU	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
		and contingency planning <ul style="list-style-type: none"> <li>• Reporting requirements</li> <li>• Investigation of incidents</li> <li>• Environmental monitoring requirements in the event of an emergency</li> </ul>		
11j.	- Remedial action/decontamination	<ul style="list-style-type: none"> <li>• Monitoring after an incident</li> <li>• Remediation methods</li> <li>• Public and employee protection measures after an incident</li> <li>• Availability of equipment and methods for dealing with spillages and other incidents</li> </ul>	BU	No
11k.	- Analysis of past incidents including experience feedback		GA	No
12.	Organisation of radiation protection:			
12a.	- Role of qualified experts	• The role of the Radioactive Waste Adviser	DU	No
		• The role of other experts employed to advise on	BU	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
		radiological protection.		
12b.	- Safety culture (importance of human behaviour)		BU	No
12c.	- Communication skills (skills and ability to instil safety culture into others)	<ul style="list-style-type: none"> <li>Effective communication</li> </ul>	BU	No
12d.	- Record keeping (sources, doses, unusual occurrences etc)	<ul style="list-style-type: none"> <li>Record keeping to comply with legislative requirements</li> <li>Content, format and maintenance of records</li> </ul>	BU	Yes
12e.	- Permits to work and other authorisations		GA	No
12f.	- Designation of areas and classification of workers	<ul style="list-style-type: none"> <li>Controlled and supervised areas</li> </ul>	GA	No
12g.	- Quality control/auditing	<ul style="list-style-type: none"> <li>Role of RWA in quality control/auditing</li> <li>Role of 3rd party auditors</li> <li>Dealing with inspections</li> </ul>	BU	No

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
12h.	- Dealing with contractors	<ul style="list-style-type: none"> <li>Advising the permit holder on appropriate procedures for ensuring that any contractors (including visitors) comply with the requirements of permits in relation to radioactive waste management and environmental radiation protection.</li> </ul>	GA	No
13.	Waste management			
13a.	- Radioactive waste management	<ul style="list-style-type: none"> <li>Sources of radioactive waste, waste types, waste classification and waste characterisation</li> <li>Principles of radioactive waste management: dilute and disperse, concentrate and contain, storage for decay and clearance from control</li> <li>The waste hierarchy: <ul style="list-style-type: none"> <li>avoidance</li> <li>minimisation</li> <li>reuse</li> <li>recycle</li> <li>disposal</li> </ul> </li> <li>Storage options for radioactive waste</li> </ul>	DU	Yes

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
		<ul style="list-style-type: none"> <li>• Treatment options for radioactive waste</li> <li>• Management of disused sealed sources: technical options and safety aspects</li> <li>• Disposal options for radioactive waste</li> </ul>		
13b.	- Radioactive waste assay	<ul style="list-style-type: none"> <li>• Sampling methodologies and minimisation of secondary waste</li> <li>• Assay methodologies               <ul style="list-style-type: none"> <li>○ Uncertainties and limitations in assay data</li> <li>○ Assay recording methods</li> </ul> </li> </ul>	BU	No
13c.	- Radioactive waste disposal	<ul style="list-style-type: none"> <li>• Disposal options for radioactive waste.</li> </ul>	DU	Yes
14.	Transport	<ul style="list-style-type: none"> <li>• Transport of radioactive materials               <ul style="list-style-type: none"> <li>○ Packaging of radioactive materials and waste for transport</li> <li>○ Security of radioactive materials during transport</li> </ul> </li> <li>• Transport documentation – dispatch and receipt</li> </ul>	GA	No
15.	Optimisation techniques	<ul style="list-style-type: none"> <li>• How to apply the BAT/BPM condition, and audit against BAT/BPM requirements, in relation to:               <ul style="list-style-type: none"> <li>○ Facility design</li> </ul> </li> </ul>	DU	Yes

Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
	- BAT/BPM	<ul style="list-style-type: none"> <li>○ Facility operation, including abatement of discharges</li> <li>○ Minimisation of risk</li> <li>○ Radioactive waste management</li> <li>○ Facility decommissioning</li> <li>● Appropriate balance between employee dose and public dose</li> </ul>		
16.	Environmental monitoring	<ul style="list-style-type: none"> <li>● Environmental monitoring: atmosphere, water bodies, foodstuffs, other environmental indicators, verification of compliance with derived environmental reference levels, survey techniques.</li> <li>● Tools available for environmental radiation monitoring</li> <li>● Sampling and analysis methods for environmental measurements</li> <li>● Mapping and data presentation for environmental data</li> <li>● Monitoring at source: external radiation and liquid</li> </ul>	BU	No



Number	Topic	Content	Competence	
			Overall level	Demonstration of experience
		and gaseous effluents, verification of compliance with discharge limits • Application to different sources.		
17.	Security of radioactive materials	• Understanding of where to get advice. • Security requirements for radioactive sources (e.g. from CPNI/NaCTSO or OCNS). • Understanding the purpose and use of a security plan. • Understanding of protecting information.	BU	No