



Fundamentals of the management of radioactive waste

An introduction to the management of higher-level radioactive waste on nuclear licensed sites

Guidance from the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency to nuclear licensees

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Foreword

In producing guidance to nuclear licensees on the management of higher-level radioactive wastes, the Health and Safety Executive (HSE), the Environment Agency and the Scottish Environment Protection Agency (SEPA) (together referred to as the regulators) received comments that it would be useful to have an introductory document explaining the context of radioactive waste management.

This introductory document aims to fulfil that role by explaining:

- what radioactive waste is;
- what happens to radioactive waste;
- who is involved in radioactive waste management;
- what their roles are; and
- how radioactive waste management is regulated.

This introductory document does not form part of the guidance.

The regulators are producing the guidance in a modular format. The appendix lists those parts of the guidance that are available, together with a list of modules that will be produced. Where modules have not yet been produced, the appendix references other existing guidance that can be consulted in the mean time.

Fundamentals of the management of radioactive waste

What is radioactive waste?

Definition of radioactive waste

Radioactive waste is any material that is either radioactive itself or is contaminated by radioactivity, for which no further use is envisaged. Government policy means that certain nuclear materials such as uranium, plutonium and spent nuclear fuel have not been declared as wastes by their owners.

Categories of radioactive waste

The term 'radioactive waste' covers a wide variety of material, ranging from wastes that can be put safely into a dustbin to items that need remote handling, heavy shielding and cooling to be managed safely. To be clear, radioactive waste is considered in different categories. These are:

High-level waste (HLW)

Radioactive waste that is radioactive enough for the decay heat to significantly increase its temperature and the temperature of its surroundings. This means that heat generation has to be taken into account when designing storage and disposal facilities.

This category of waste includes:

- the liquid residue that contains most of the radioactivity from the reprocessing of spent nuclear fuel;
- this material following solidification;
- spent fuel (if it is declared a waste); or
- any other waste with similar radiological characteristics.

Intermediate-level waste (ILW)

Intermediate-level waste has radioactivity levels that are higher than low-level waste (see below) but which do not generate enough heat to require special storage or disposal facilities. However, like other radioactive waste it still needs to be contained to protect workers from the radiation. ILW arises mainly from the reprocessing of spent fuel and from general operations and maintenance at nuclear sites, and can include metal items such as fuel cladding and reactor components, graphite from reactor cores, and sludges from the treatment of radioactive liquid effluents.

Low-level waste (LLW)

Most LLW today arises from the operation of nuclear power stations and nuclear fuel reprocessing facilities, as well as the decommissioning and clean up of nuclear sites. Operational LLW is principally lightly contaminated miscellaneous waste arising from maintenance and monitoring, such as plastic, paper and metal. LLW from decommissioning is mainly soil, building materials and metal plant and equipment. Most LLW from nuclear licensed sites is currently disposed of at the Low-Level Waste Repository (LLWR) near Drigg in Cumbria.

Very low-level waste (VLLW)

VLLW is a subset of LLW and falls into two distinct categories:

- **Low-volume VLLW ('dustbin disposal')**: Radioactive waste that can be safely disposed of to an unspecified destination with municipal, commercial or industrial waste. The radioactive risk from such material is low enough that controls on disposal of this material, after removal from the premises where the wastes arose, are not necessary.
- **High-volume VLLW ('bulk disposal')**: Radioactive waste that can be disposed of to specified landfill sites. After the waste is removed from its site of origin, it will be subject to controls on its disposal, which will be specified by the environmental regulators.

Exempt waste

Some radioactive waste is exempted from regulation by an Exemption Order issued under the Radioactive Substances Act 1993 (RSA93).^{L1} Exempt waste does not need an authorisation for disposal.

What happens to radioactive waste?

Once created, radioactive waste will undergo some of the following stages depending on the type of waste and the strategy for its management:

Pretreatment is the initial step that occurs just after waste generation. It may involve collection, segregation, chemical adjustment and decontamination and may also include a period of interim storage. The aim of this step is to segregate waste into streams that will be managed in similar ways, and to isolate non-radioactive wastes or those materials that can be recycled.

Treatment involves changing the characteristics of the waste by volume reduction, radionuclide removal or change of composition. Typical treatment operations include:

- compaction of dry solid waste or incineration of solid or organic liquid wastes (volume reduction);
- filtration or ion exchange of liquid waste (radionuclide removal); and
- precipitation or flocculation of chemical species (change of composition).

Conditioning involves transforming radioactive waste into a form that is suitable for handling, transportation, storage and disposal. This might involve immobilisation of radioactive waste, placing waste into containers or providing additional packaging. Common immobilisation methods include solidification of LLW and ILW liquid radioactive waste in cement, and vitrification of HLW in a glass matrix. Immobilised waste may be placed in steel drums or other engineered containers to create a waste package.

Storage of radioactive waste may take place at any stage in the radioactive waste management process and aims to isolate the radioactive waste, help protect the environment and make it easier to control its disposal. Storage may be used to make the next step in the management process more straightforward or to act as a buffer between or within steps. Waste might be stored for many years before it undergoes further processing and disposal. Some storage facilities are located within a nuclear power plant or a licensed disposal facility, others are separate facilities.

Retrieval involves recovering waste packages from storage either for inspection, for disposal or for further storage in new facilities. Some storage facilities are designed so the equipment that deposits waste can be operated in reverse to retrieve waste packages. Others may need retrieval equipment to be installed.

Disposal occurs when packages of radioactive waste are deposited in a disposal facility with no intention of retrieval. Disposal may also include discharging radioactive wastes such as liquid and gaseous effluent into the environment and transfer of wastes from one site to another.

These basic steps in radioactive waste management are illustrated in Figure 1.

Which steps are employed in a particular situation depends on the types of radioactive waste and the methods of radioactive waste management that are to be used. In some cases individual steps may be closely linked or carried out together. The whole process needs to take place so that the way wastes are managed at each step is compatible with the subsequent steps.

On most nuclear licensed sites there are a number of radioactive wastes to manage, particularly if nuclear facilities are being decommissioned. In all cases, an integrated approach to managing radioactive wastes and non-radioactive wastes is required.

Fundamental principles of radioactive waste management

Objective of radioactive waste management

The objective of radioactive waste management is to control and account for radioactive waste to protect human health and the environment now, but also to make sure we do not leave unnecessary burdens for future generations.

The preferred way to do this, where reasonably practical, is to concentrate and contain the waste and to isolate it from the environment. This allows any releases to the environment to be restricted and subject to regulatory control.

Principles of radioactive waste management

The HSE's Safety Assessment Principles^{R1} set out the basic principles of radioactive waste management:

- A strategy should be produced and implemented for managing radioactive waste on a site. This should be consistent with government policy, including the government's overall policy aims on sustainable development, should take into account the possible consequences for present and future generations and should consider the environment and non-human species.
- Where reasonably practicable, radioactive waste generation should be prevented or minimised, both in terms of quantity and activity.
- The accumulation of radioactive waste on site should be minimised.
- Characterisation and segregation of radioactive waste should be used to help ensure subsequent management is safe and effective.
- Radioactive waste should be stored using good engineering practice and in a passively safe condition.
- Radioactive waste should be processed into a passively safe state as soon as is reasonably practical.
- Information that might be required now and in the future for the safe management of radioactive waste should be recorded and preserved.

Policy and regulatory objectives

Government policy

The last full statement of government policy on radioactive waste management was in Cm2919.^{G1} This has been amended or elaborated as follows:

- *The Decommissioning of the UK Nuclear Industry's Facilities* September 2004^{G2} replaces paragraphs 120–131 of Cm2919;
- *Intermediate Level Radioactive Waste Substitution* December 2004^{G3} replaces paragraphs 140–141 and 186 of Cm2919;
- *Response to the Report and Recommendations from the Committee on Radioactive Waste Management (CoRWM) By the UK Government and the devolved administrations* Department for Environment, Food and Rural Affairs (Defra), National Assembly for Wales (NAW), Department of the Environment for Northern Ireland and the Scottish Executive, October 2006.^{G4}

The regulators will take account of any future revision to this policy and amend this guidance as appropriate.

As stated in Cm2919 paragraph 52(2), the regulators have the duty to ensure that the government's policy framework described is properly implemented in accordance with their statutory powers.

Regulatory objectives

The regulators look to licensees to demonstrate strategic planning for managing all radioactive material and radioactive waste. This includes developing programmes for disposing of waste and the long-term management of material that may become waste at some time in the future. Strategies should be integrated within a single site and nationally where appropriate, to make sure the overall safety is maintained while the environmental impact is minimised.

The regulators will be looking to see that the traditional waste hierarchy is applied in the strategies. This involves:

- avoiding producing radioactive waste where reasonably practicable;
- where waste does need to be produced, reducing this as much as reasonably practicable;
- reusing or recycling material that forms radioactive waste where reasonably practicable;
- only disposing of radioactive waste that cannot otherwise be dealt with.

In terms of practical radioactive waste management, the regulators will be looking to see that, where reasonably practicable, licensees characterise and segregate their radioactive waste on the basis of physical and chemical properties and then store the waste in accordance with the principles of passive safety. The regulators will also be looking to see that licensees manage radioactive material and radioactive waste in a manner that is compatible with future potential disposal requirements.

More details on the regulatory objectives are provided in guidance to inspectors^{R2} and in Part II of this guidance.

Who is responsible?

Licensees

Licensees bear the prime responsibility for safety and environmental protection.

Licensees bear the prime responsibility for safety and environmental protection relating to activities carried out on their sites. Therefore HSE requires that the licensee has an adequate management structure, capability and resources to do this before granting a nuclear site licence.^{R3} Licensees must produce safety cases for all operations, including radioactive waste conditioning operations, which consider safety, radioactive waste management and environmental protection.

In some cases, the licensee's own requirements or the site licence might mean that radioactive waste conditioning operations cannot continue without the permission of HSE.

The cost of regulation is met by licensees through charges made by HSE under section 24A of the Nuclear Installations Act 1965^{L2} (as amended). These costs include the cost of advice given to HSE by the Environment Agency or SEPA.

HSE/ND

HSE regulates radioactive waste management through conditions attached to the nuclear site licence.

HSE makes sure that the public and workers are protected from radiation by securing effective control of health, safety, radioactive waste management and security at nuclear sites. It acts in this area through the Nuclear Installations Inspectorate (NII), the enforcing part of its Nuclear Directorate (ND). These bodies enforce the Health and Safety at Work etc Act 1974^{L3} and associated statutory provisions in Great Britain, including the Nuclear Installations Act 1965^{L2} (as amended) and the Ionising Radiations Regulations 1999.^{L4}

HSE is responsible for regulating radioactive waste management through conditions attached to the nuclear site licence.^{L5}

A series of Memoranda of Understanding (MoU)^{R4,R5} ensure that HSE consults the Environment Agency or SEPA on radioactive waste management activities and

means that they will not give permission without taking full and meaningful account of any environmental issues raised.

The Office for Civil Nuclear Security (OCNS) (part of HSE's Nuclear Directorate) is the security regulator for the UK's civil nuclear industry. It is responsible for approving security arrangements within the industry and enforcing compliance. OCNS conducts its regulatory activities on behalf of the Secretary of State for Business, Enterprise and Regulatory Reform (BERR) under the authority of the Nuclear Industries Security Regulations 2003 (NISR03).^{L6} OCNS also undertakes vetting of nuclear industry personnel with access to sensitive nuclear material or information. It works in close conjunction with policy officials in BERR, with other government departments and agencies, and with overseas counterparts.

The Environment Agency and the Scottish Environment Protection Agency

The Environment Agency and SEPA regulate any disposal, discharge or off-site transfer of radioactive waste through authorisations issued under RSA93.

The Environment Agency takes a leading role in protecting and improving the environment in England and Wales while the Scottish Environment Protection Agency (SEPA) has similar responsibilities in Scotland. These responsibilities include enforcing the the Radioactive Substances Act 1993 (RSA93)^{L1} and the Environment Act 1995.^{L7}

This means that these agencies are responsible under RSA93 for authorising any disposal, discharge or off-site transfer of radioactive waste.

Under section 37(3) of the Environment Act 1995 (EA95), the Environment Agency or SEPA may provide advice 'as respects any matter in which they have skill or experience'. This includes advising HSE on the long-term disposability of conditioned waste, and ensuring waste is managed in a sustainable way, taking into account long-term environmental considerations. Under section 37(1) of EA95, the environment agencies charge HSE for that advice.

In addition, the environment agencies scrutinise the concepts that the Nuclear Decommissioning Authority's Radioactive Waste Management Directorate (NDA(RWMD)) has developed for assessing the disposability of waste packages to ensure that these concepts are fit for purpose.

Under the terms of the MoU,^{R4,R5} the Environment Agency or SEPA consult HSE and will not authorise the disposal of radioactive waste without taking full and meaningful account of any health and safety issues raised.

Department for Transport

The Secretary of State for Transport is responsible for regulating the safe transport of radioactive materials in the United Kingdom. The Radioactive Materials Transport Division of the Department for Transport works on behalf of the Secretary of State to develop regulations, assess and approve package designs and ensure that the regulations are complied with.

NDA

The Nuclear Decommissioning Authority (NDA) is responsible for the decommissioning and clean up of all civil public-sector nuclear sites in the UK, including the management of radioactive wastes. NDA establishes waste management plans with its site licensee companies (SLCs), and consults on these plans with the regulators, as described in the Energy Act 2004.^{L8} In accordance

with the government announcement of 25 October 2006,^{G4} NDA is also responsible for implementing the UK's geological disposal programme.

(Potential) disposal site operators

Operators of radioactive waste disposal sites in the UK are responsible for operating their sites according to the terms of authorisations granted by either the Environment Agency or SEPA. As part of this, they must set out conditions for acceptance of waste, which can be used by nuclear site licensees to demonstrate in their conditioning proposals that wastes are disposable.

The government has announced^{G4} moves towards disposing of a range of higher-activity radioactive wastes (HLW, ILW and some LLW) in deep geological repositories. NDA(RWMD) is the body that will advise licensees, through the Letter of Compliance (LoC) process, on the packaging and conditioning of radioactive wastes until a repository operating company is set up.

A different policy applies in Scotland, where the preference is for long-term, near-surface, near-site storage of higher-activity wastes. The regulators consider that wastes packaged and conditioned in anticipation of deep geological disposal are also suitable for long-term storage, as required by the government policy in Scotland.

How is radioactive waste management regulated?

Matters covered by this guidance

Safety of workers and the general public

The main legislation covering the safety of workers and the general public at nuclear installations in the UK is the Health and Safety at Work etc Act 1974^{L3} and various associated pieces of legislation such as the Nuclear Installations Act 1965^{L2} (as amended) and the Ionising Radiations Regulations 1999.^{L4} These are enforced by HSE.

Radioactive waste management on nuclear licensed sites

The way in which radioactive waste is managed on licensed nuclear sites is set out in the conditions^{L5} attached to the nuclear site licence and is enforced by HSE. These conditions include some of particular relevance:

- Licence Condition 4 requires that no nuclear matter (which includes radioactive waste) is brought onto or stored on the site unless adequate arrangements are made by the licensee.
- Licence Condition 25 requires that adequate records are kept of the amount and location of radioactive waste used, stored or accumulated on site at any time.
- Licence Condition 32 requires that the production and total quantity of radioactive waste stored on the site is minimised.
- Licence Condition 33 gives power to HSE to ensure that radioactive waste is only disposed of in an authorised manner, to comply with the Radioactive Substances Act 1993.
- Licence Condition 34 requires that radioactive waste on the site is adequately controlled or contained at all times.
- Licence Condition 35 requires that adequate arrangements are made for decommissioning.

Other related legislation

The legislation described above directly relates to this guidance, however, other legislation does apply:

Disposal of radioactive waste from nuclear licensed sites

The disposal of radioactive waste, including airborne and liquid discharges from sites and transfers of waste between sites, is regulated by the Environment Agency in England and Wales and SEPA in Scotland, under the Radioactive Substances Act 1993^{L1} and the Environment Act 1995.^{L7}

Transport of radioactive waste

The Competent Authority in the UK for approving packages for transporting radioactive material is the Radioactive Materials Transport Division of the Department for Transport (DfT). A guide from DfT^{G5} describes the requirements for applications, based on the requirements set out in International Atomic Energy Authority (IAEA) guidance.^{L9}

Security

The Nuclear Industries Security Regulations 2003^{L6} aim to ensure the security of nuclear material and related equipment and information, and are enforced by OCNS.

Safeguards

The Euratom Treaty^{L10} and agreements between the UK, Euratom and IAEA¹¹ contain safeguards provisions for nuclear material contained in certain kinds of waste in the UK. This includes plutonium (all isotopes), uranium (natural, depleted and enriched) and thorium. These safeguards are based on nuclear materials accountancy measures, including nuclear material inventories (ie how much material there is and where it is) and information about the design of the nuclear facilities concerned. The safeguards inspectorates of the European Commission and/or IAEA perform inspections to verify that the facility design and the amounts of nuclear material present are as declared. The UK's safeguards agreement with Euratom and IAEA is now supplemented by an Additional Protocol to that agreement,¹² and the application of all safeguards measures in the UK is described further on the non-proliferation section of the Department of Business, Enterprise and Regulatory Reform website www.berr.gov.uk/energy/non-proliferation/nuclear/index.html.

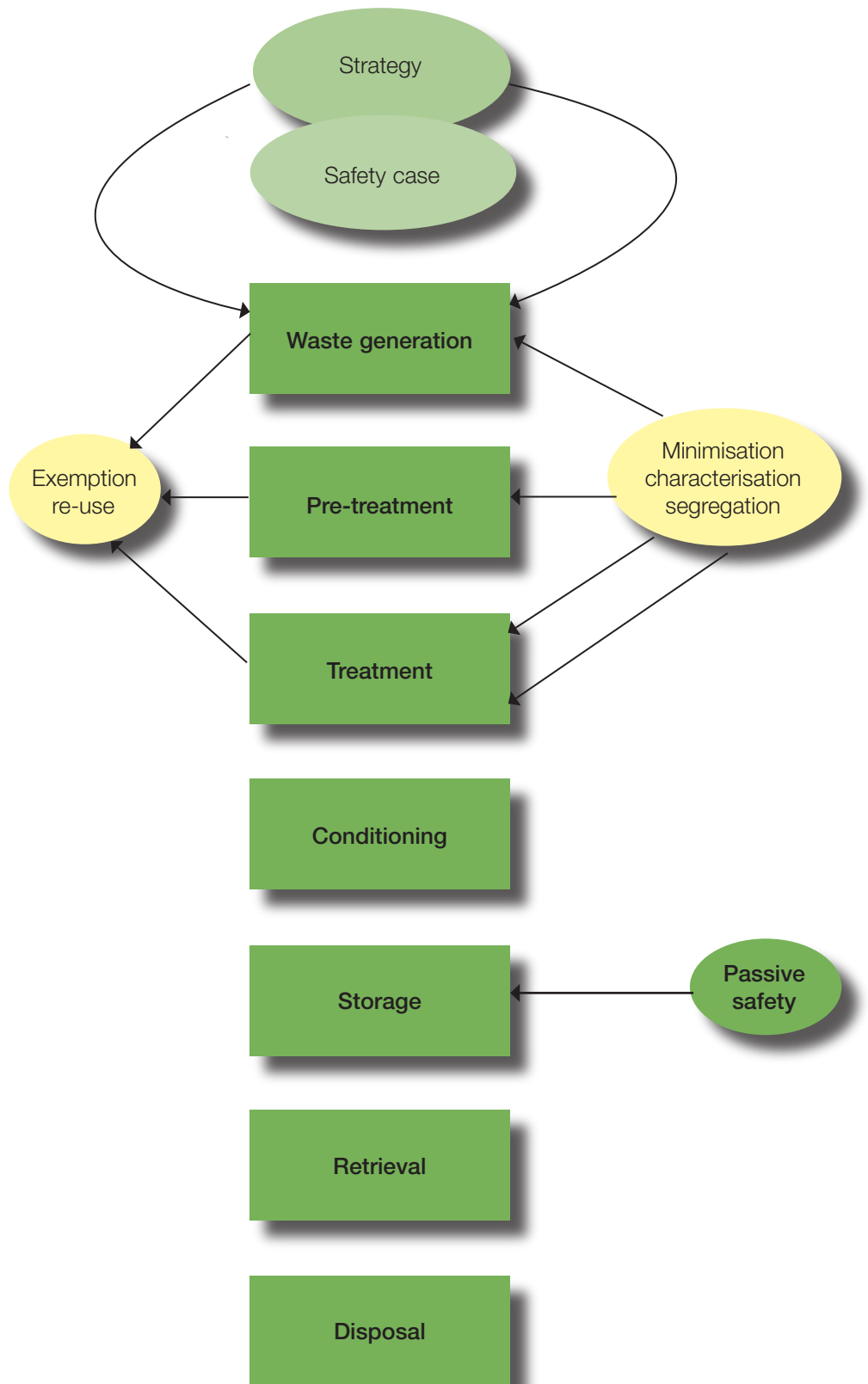


Figure 1 The basic steps of radioactive waste management

Appendix

This appendix is a temporary part of the documentation, aimed at indicating the proposed scope of the guidance and indicating where advice or guidance can be obtained until the revised guidance is complete.

The guidance is in two parts with an introduction that is not part of the guidance.

This introduction sets out the scope, aims and context of the guidance. We have produced it in response to comments received on the draft of Part I indicating that members of the public would find it useful to have a general description of what radioactive waste is, what happens to it, who is responsible and how it is regulated, to help them understand the guidance itself.

Part I gives guidance on the regulatory process and is now published.

Part II gives technical guidance on a number of relevant topics. This part is modular covering the following:

- Part IIA The radioactive waste management case
- Part IIB Conditioning and disposability
- Part IIC Radioactive waste management strategies
- Part IID Waste minimisation, characterisation and segregation
- Part IIE Control, accountancy and records
- Part IIF Storage of radioactive waste

The Part II guidance will be issued as each module is completed. Until these modules are available, licensees should refer to the following documents for advice:

Radioactive waste management case

Guidance on the Purpose, Scope and Content of Nuclear Safety Cases Technical Assessment Guide T/AST/051 NSD, HSE
www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/TAST051.pdf

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendix 3 T/AST/024 NSD, HSE
March 2001
www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

Conditioning and disposability

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendix 4 T/AST/024 NSD, HSE
March 2001
www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

Radioactive waste management strategies

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendix 2 T/AST/024 NSD, HSE
March 2001
www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

Waste minimisation, characterisation and segregation

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendix 5 T/AST/024 NSD, HSE March 2001

www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

Control accountancy and records

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendix 7 T/AST/024 NSD, HSE March 2001

www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

Storage of radioactive waste

Guidance for Inspectors on the Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites Appendices 4&6 T/AST/024 NSD, HSE March 2001

www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

References and further reading

(References to websites were current in October 2007)

Legislation

L1 *Radioactive Substances Act 1993 (c.12)* The Stationery Office 1993
ISBN 978 0 10 541293 9

L2 *Nuclear Installations Act 1965 (c.57)* The Stationery Office 1965
ISBN 978 0 10 850216 3

L3 *Health and Safety at Work etc Act 1974 (c.37)* The Stationery Office 1974
ISBN 978 0 10 543774 1

L4 *Ionising Radiations Regulations 1999* SI 1999/3232 The Stationery Office 1999
ISBN 978 0 11 085614 8

L5 *Nuclear site licence conditions* HSE www.hse.gov.uk/nuclear/silicon.pdf

L6 *Nuclear Industries Security Regulations 2003* SI 2003/403 The Stationery Office 2003
ISBN 978 0 11 045397 2

L7 *Environment Act 1995 (c.25)* The Stationery Office 1995
ISBN 978 0 10 542595 3

L8 *Energy Act 2004 (c.20)* The Stationery Office 2004 ISBN 978 0 10 542004 8

L9 *Regulations for the Safe Transport of Radioactive Material* IAEA Safety Standard Series No. TS-R-1 (ST-1 Revised) 1996 Edition

L10 Chapter 7 of the Treaty establishing the European Atomic Energy Community (Euratom) and 'Commission Regulation (Euratom) No 302/2005 of 8 February 2005

on the application of Euratom safeguards – Council/Commission statement' Official Journal 28.02.2005 **L54** 1–71

L11 'Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers of ionising radiation' (The Basic Safety Standards Directive (BSS))
http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf

Government policy and publications

G1 *Review of Radioactive Waste Management Policy: Final Conclusions* Cm2919 The Stationery Office July 1995

G2 *The decommissioning of the UK nuclear industry's facilities* DTI September 2004 www.dti.gov.uk/files/file30124.pdf

G3 *Intermediate level radioactive waste substitution* DTI December 2004 www.dti.gov.uk/files/file30058.pdf

G4 *Response to the Report and Recommendations from the Committee on Radioactive Waste Management (CoRWM) by the UK Government and the devolved administrations* Defra, National Assembly for Wales (NAW), Department of the Environment for Northern Ireland and the Scottish Executive, October 2006 www.defra.gov.uk/environment/radioactivity/waste/pdf/corwm-govresponse.pdf

G5 *Guide to an Application for UK Competent Authority Approval of Radioactive Material in Transport (IAEA 1996 Regulations)* DETR/RMTD/0003 Radioactive Materials Transport Division, DfT January 2001 www.dft.gov.uk/pgr/freight/dgt1/guidance/guidance7class/applicantsguide

G6 *Managing Radioactive Waste Safely. Proposals for Developing a Policy for Managing Solid Radioactive Waste in the UK* Defra, National Assembly for Wales (NAW), Department of the Environment for Northern Ireland and the Scottish Executive, September 2001

G7 *Managing the Nuclear Legacy. A Strategy for Action* DTI July 2002

G8 *RWPG Sponsored Workshops on Interim Safe Storage Report* DEFRA/RAS/04.001 28 November 2003 Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of Euratom safeguards – Council/Commission statement
Official Journal 28.02.2005 **L54** 1–71 www.defra.gov.uk/environment/radioactivity/publications/complete/pdf/defra_ras-04.001.pdf

G9 *Report on RWPG Sponsored Compatibility Workshop Report* DEFRA/RAS/04.007 11 February 2004 www.defra.gov.uk/environment/radioactivity/publications/complete/pdf/defra_ras-04.007.pdf

G10 *Managing our Radioactive Waste Safely: CoRWM's recommendations to Government* Committee on Radioactive Waste Management 31 July 2006 www.corwm.org.uk/pdf/FullReport.pdf

Guidance and documents from the regulators and NDA

R1 *Safety Assessment Principles for Nuclear Facilities* HSE www.hse.gov.uk/nuclear/saps/index.htm

- R2 *Guidance for inspectors on the management of radioactive materials and radioactive waste on nuclear licensed sites* NSD, HSE March 2001
www.hse.gov.uk/nuclear/waste1.pdf
- R3 *The licensing of nuclear installations* HSE 2007
www.hse.gov.uk/nuclear/notesforapplicants.pdf
- R4 *Memorandum of Understanding between the Health and Safety Executive and the Environment Agency on Matters of Mutual Concern at Nuclear Sites Licensed by HSE in England and Wales* www.hse.gov.uk/nuclear/nucmou.pdf
- R5 *Memorandum of Understanding between the Health and Safety Executive and the Scottish Environment Protection Agency on Matters of Mutual Concern at Licensed Nuclear Sites in Scotland*
www.hse.gov.uk/aboutus/framework/mou/sepa-nuclear.pdf
- R6 *Guidance on the purpose, scope and content of nuclear safety cases*
 Technical Assessment Guide T/AST/051 NSD, HSE
www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/TAST051.pdf
- R7 *Radioactive Substances Regulation Environmental Principles (Interim)*
 Environment Agency
<http://publications.environment-agency.gov.uk/pdf/GEHO0606BLSO-e-e.pdf>
- R8 *Guidance for the Environment Agencies' Assessment of Best Practicable Environmental Option Studies at Nuclear Sites* Environment Agency and SEPA 2004
<http://publications.environment-agency.gov.uk/pdf/PMHO0204BKHK-e-e.pdf>
- R9 *Specification for the Content and Format of a Site Integrated Waste Strategy Document* ENG01 NDA
www.nda.gov.uk/documents/upload/eng01_specification_for_content_and_format_of_site_integrated_waste_strategy_document_revision_2.pdf
- R10 *Companion Document to Integrated Waste Strategy Specification* ENG02 NDA
www.nda.gov.uk/documents/upload/eng02_companion_document_to_integrated_waste_strategy_specification_revision_2.pdf
- R11 *Memorandum of Understanding Between the Nuclear Decommissioning Authority and the Environment Agency*
www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=3107
- R12 *Memorandum of Understanding between the Nuclear Decommissioning Authority and the Scottish Environment Protection Agency*
www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=3122

International

- I1 *Agreement of 6 September 1976 Between the United Kingdom of Great Britain and Northern Ireland, the European Atomic Energy Community and the Agency [IAEA] in connection with the Treaty on the Non-Proliferation of Nuclear Weapons* the text of which is published by the IAEA as Information Circular (INFCIRC) number 263
- I2 *Protocol Additional to the Agreement between the United Kingdom of Great Britain and Northern Ireland, the European Atomic Energy Community and the International Atomic Energy Agency for the application of safeguards in the United*

Kingdom of Great Britain and Northern Ireland in connection with the Treaty on the Non-Proliferation of Nuclear Weapons Vienna, 22 September 1998 [Cm 4282]

13 *Predisposal Management of Low and Intermediate Level Radioactive Waste* IAEA Safety Standard Series Safety Guide No WS-G-2.5 2003
www-pub.iaea.org/MTCD/publications/PDF/Pub1150_web.pdf

14 *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* INFCIRC/546 IAEA 24 December 1997

15 *Predisposal Management of Low and Intermediate Level Radioactive Waste Including Decommissioning Requirements* IAEA Safety Standard Series Safety Guide No. WS-R-2 www-pub.iaea.org/MTCD/publications/PDF/P089_scr.pdf

16 *Storage of Radioactive Waste* IAEA Safety Standard Series Guide No WS-G-6.1 December 2006 www-pub.iaea.org/MTCD/publications/PDF/Pub1254_web.pdf

Glossary

characterisation characterisation of radioactive waste involves determining its physical, chemical and radiological properties. It may be carried out in association with several of the other basic steps. It may be required for record keeping, moving waste between steps and also to determine the best method of managing waste.

clearance clearance is where radioactive materials and their management are removed from within a process of regulatory control. It is particularly relevant to the management of wastes produced in decommissioning. Article 5 of the Euratom Basic Safety Standards (BSS)^{L11} provides guidance on which materials can be removed from regulation.

conditioning conditioning involves transforming radioactive waste into a form suitable for handling, transportation, storage and disposal. This may include immobilisation of radioactive waste, placing waste into containers and providing additional packaging. Common immobilisation methods include solidification of LLW and ILW liquid radioactive waste, for example in cement, and vitrification of HLW in a glass matrix. Immobilised waste may be placed in steel drums or other engineered containers to create a waste package.

disposal disposal is the authorised emplacement of packages of radioactive waste in a disposal facility without the primary intention of retrieval. Disposal may also include discharging radioactive wastes such as liquid and gaseous effluent into the environment and transfer from one site to another.

exemption radioactive waste can be exempted from specific regulatory control if:

- for certain natural radionuclides in the uranium and thorium decay chains, levels are below those specified in Schedule 1 of RSA93; or
- for other artificial or man-made radionuclides, the levels are below those laid down in the current suite of Exemption Orders issued under RSA93, and they meet the controls specified in the Exemption Order.

The most notable of these is the Substances of Low Activity (SoLA) Exemption Order. This specifies a level for exemption from regulatory control of 0.4 Becquerel (Bq)/g for wastes that are substantially insoluble in water.

exempt waste waste exempt from regulation as radioactive waste (see exemption).

high-level or heat-generating wastes (HLW) wastes in which the temperature may rise significantly as a result of their radioactivity, meaning that heat generation has to be taken into account when designing storage or disposal facilities. IAEA³ guidance is that HLW thermal power exceeds about 2 kW/m³.

intermediate-level wastes (ILW) wastes with radioactivity levels exceeding the upper boundaries for low-level wastes, but which do not require heating to be taken into account in the design of storage or disposal facilities. IAEA guidance³ is that ILW thermal power is below about 2 kW/m³.

Letter of Compliance (LoC) documentation provided by NDA(RWMD) to a licensee (or anyone producing conditioned waste packages) indicating how well the proposed waste package would fit in the anticipated safety case for a repository. This information can be used by licensees to demonstrate to the regulators that the proposed packages should be disposable.

low-level wastes (LLW) radioactive waste having a radioactive content not exceeding four Gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma activity.* The lower activity limit for LLW, below which waste is not required to be subject to specific regulatory control, is covered by exemption orders under RSA93.

very low-level radioactive waste (VLLW) is a subset of LLW (see VLLW).

minimisation minimisation of waste is fundamental good practice in radioactive waste management. It should be considered during the design of facilities and applied during all of the basic steps. Effective methods of minimising the accumulation of radioactive waste include the clearance of waste that is exempt from regulatory control and the reuse or recycling of radioactive material.

NDA (Nuclear Decommissioning Authority) a non-departmental public body set up, under the Energy Act 2004, by the government in 2005 with a vision to ensure the safe, accelerated and affordable clean up of the UK's civil nuclear legacy.

NDA(RWMD) the Radioactive Waste Management Directorate of NDA.

nuclear matter includes radioactive materials and radioactive waste, as defined in section 26 of the Nuclear Installations Act 1965 (as amended):

- (a) any fissile material in the form of uranium metal, alloy or chemical compound (including natural uranium), or of plutonium metal, alloy or chemical compound, and any other fissile material which may be prescribed;
- (b) any radioactive material produced in, or made radioactive by exposure to the radiation incidental to, the process of producing or utilising any such fissile material as aforesaid;
- (c) any substance which meets the definition of radioactive waste in the Radioactive Substances Act.

passive safety providing and maintaining a safety function by minimising the need for active safety systems, monitoring or prompt human intervention.

*Policy for the Long Term Management of Solid Low Level Radioactive Waste in the United Kingdom
Defra, DTI and Devolved Administrations 26 March 2007

pretreatment the initial step that occurs just after generation. It may consist of collection, segregation, chemical adjustment and decontamination and may include a period of interim storage. This step provides the best opportunity for segregating waste streams according to how they will be managed and to isolate those non-radioactive or recyclable wastes.

radioactive material defined in section 1 of RSA93 as a substance, not being waste, falling within either or both of the following descriptions:

- (a) a naturally occurring substance containing an element specified in Schedule 1 of the Act which is present at specific activity levels greater than those given in that Schedule;
- (b) any substances which are not naturally occurring, whose radioactivity is wholly or partly due to nuclear fission, neutron or ionising radiation.

radioactive waste defined in section 2 of RSA93 as waste which consists wholly or partly of:

- (a) a substance or article which, if it were not waste, would be radioactive material, or
- (b) a substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity to other waste falling within paragraph (a) or this paragraph.

Section 14(4) of RSA93 states that:

'... where radioactive material is produced, kept or used on any premises, and any substance arising from the production, keeping or use of that material is accumulated in a part of the premises appropriated for the purpose, and is retained there for a period of not less than three months, that substance shall, unless the contrary is proved, be presumed –

- (a) to be radioactive waste, and*
- (b) to be accumulated on the premises with a view to subsequent disposal of the substance.'*

retrieval retrieval is the recovery of waste packages from storage either for inspection purposes, for subsequent disposal or further storage in new facilities. Storage facilities may be designed so the original emplacement equipment may be operated in reverse to retrieve waste packages. Others may require the installation of retrieval equipment at the appropriate time.

segregation segregation of radioactive waste involves accumulating wastes with similar physical, chemical and radiological properties and that will be subject to similar methods or options for future management. Mixing together radioactive wastes that have different properties and different methods of future management is avoided. It is most effectively carried out during the early steps of radioactive waste management.

storage storage of radioactive waste may take place at any stage in the radioactive waste management process and aims to isolate the radioactive waste, help protect the environment and make it easier to control its disposal. Storage may be used to make the next step in the management process more straightforward, or to act as a buffer between or within steps. Waste might be stored for many years before it undergoes further processing and disposal. Some storage facilities are located with a nuclear power plant or a licensed disposal facility, others are separate facilities.

treatment treatment involves changing the characteristics of the waste. Basic treatment concepts are volume reduction, radionuclide removal and change of composition. Typical treatment operations include incineration or compaction of dry solid waste or organic liquid wastes (volume reduction), filtration or ion exchange of liquid waste (radionuclide removal) and precipitation or flocculation of chemical species (change of composition).

very low-level wastes (VLLW) a sub-category of LLW. In the case of low volumes ('dustbin disposal'), this is categorised as low volume VLLW:

Radioactive waste which can be safely disposed of to an unspecified destination with municipal, commercial or industrial waste ('dustbin disposal'), each 0.1 m³ of waste containing less than 400 kilobecquerels (kBq) of total activity or single items containing less than 40 kBq of total activity. For wastes containing carbon-14 or hydrogen-3 (tritium):

- in each 0.1 m³, the activity limit is 4000 kBq for carbon-14 and hydrogen-3 (tritium) taken together; and
- for any single item, the activity limit is 400 kBq for carbon-14 and hydrogen-3 (tritium) taken together.

Controls on disposal of this material, after removal from the premises where the wastes arose, are not necessary.

Bulk disposals are categorised as high volume VLLW:

- Radioactive waste with maximum concentrations of 4 Megabecquerels per tonne (MBq/te) of total activity which can be disposed of to specified landfill sites. For waste containing hydrogen-3 (tritium), the concentration limit for tritium is 40 MBq/te. Controls on disposal of this material, after removal from the premises where the wastes arose, will be necessary in a manner specified by the environmental regulators.

waste generation occurs during the operation and decommissioning of nuclear facilities. Waste generation can give rise to solid, liquid and/or gaseous wastes.

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