The management of higher activity radioactive waste on nuclear licensed sites

Part 3c
Storage of Radioactive Waste

Joint guidance from the Office for Nuclear Regulation, the Environment Agency and the Scottish Environment Protection Agency to nuclear licensees

November 2011

Contents

Foreword

The Office for Nuclear Regulation (ONR), the Environment Agency and the Scottish Environment Protection Agency (SEPA) (together referred to as the regulators) have issued this guidance jointly.

Dutyholders on nuclear licensed sites who follow this guidance will normally be doing enough to comply with the relevant law as interpreted by the regulators at the time of writing, and the regulators may refer to this guidance as illustrating relevant good practice. However, dutyholders are not required to follow this guidance and compliance with it does not automatically mean that we will approve an application for a nuclear site licence, a consent or agreement under the licence or an authorisation. The guidance provides information to other parties who may be stakeholders in how radioactive waste is managed on a nuclear licensed site.

Policies for the disposal of higher activity waste differ in Scotland and in England/Wales. We consider that packages conditioned in anticipation of geological disposal are also suitable for long-term storage, as required by government policy in Scotland. On this basis the following guidance can be used equally in England, Scotland and Wales, but any references to geological disposal will mean long-term storage when applied to Scotland. We will keep the packaging advice being developed by the Nuclear Decommissioning Authority's (NDA's) Radioactive Waste Management Directorate (RWMD) under review and if any developments mean that this assertion for Scottish waste is no longer valid, we will provide further guidance.

Given the long timescales involved in radioactive waste management, you should be aware that standards, legislation and national policy might change. While this guidance forms the best advice that the regulators can give at present, nothing in this guidance overrides, or is intended to pre-empt, the ability of the regulators to discharge their statutory powers and duties in accordance with legislation, standards and policy applicable at any time.

We will review this guidance periodically to ensure that it continues to provide sound advice.

Freedom of information – disclosure of information

The regulators are public authorities for the purposes of the Freedom of Information Act 2000 (FOIA00) and the Environmental Information Regulations 2004 (EIR04) in England and Wales, and the Freedom of Information (Scotland) Act 2002 (FOISA02) and the Environmental Information (Scotland) Regulations 2004 (EISR04) in Scotland. If we receive a request for information that we hold, we will have to consider the request in accordance with this legislation.

This document is available on our websites, in accordance with our policies of openness and transparency.

Executive summary

It will be many years before higher activity radioactive waste can be disposed of to a disposal facility. Therefore, storage plays a crucial part in the long-term management strategy by providing an extendable safe and secure means to hold waste and ensure protection of the environment. The waste should be stored in a packaged form suitable for eventual disposal.

If raw waste is stored, it should be contained in a manner that avoids deterioration and allows retrieval for processing and eventual disposal, whilst maintaining standards of safety and environmental protection that are as close as reasonably practicable to those for stored packaged wastes.

This document provides an overview of the relevant policy drivers, regulatory requirements and expectations relating to the storage of higher activity radioactive wastes on nuclear licensed sites. It also identifies the relevant technical considerations that need to be addressed in the requisite radioactive waste management cases.

Scope

1 This document is part of a suite of guidance documents covering the management of higher activity radioactive waste on nuclear licensed sites. It deals specifically with the storage of conditioned radioactive waste. Further detailed considerations for higher activity radioactive waste are covered by companion guidance modules in the 'Joint guidance' series.[1-5]

2 In the context of this guidance:

- management of radioactive waste means the whole process of managing waste from its generation to (but not including) its disposal;
- higher activity radioactive waste means HLW, ILW, and such LLW as cannot be disposed of at present. If there is doubt over how to regard a particular waste stream, the owner of that waste stream should consult the regulators.

Advice about the disposal of those categories of radioactive waste that are not covered in this guidance can be obtained from the Environment Agency or SEPA.

3 Policies for the disposal of higher activity waste differ in Scotland and in England/Wales. However, it considered that packages conditioned in anticipation of geological disposal are also suitable for long-term storage, as required by government policy in Scotland. On this basis the following guidance can be used equally in England, Scotland and Wales, but any references to geological disposal will mean long-term storage when applied to Scotland. We will keep the packaging advice being developed by the Nuclear Decommissioning Authority's (NDA's) Radioactive Waste Management Directorate (RWMD) under review and, if any developments mean that this assertion for Scottish waste is no longer valid, we will provide further guidance.

4 Licensees are reminded that the same safety and environmental standards apply to all activities involving radioactive materials whether or not the material involved is declared as radioactive waste.

Objective and aims of this document

5 The objective of this document is to provide guidance on complying with the legislation below in accordance with current policy by describing regulatory expectations in relation to the storage of conditioned, higher activity radioactive waste.

Applicable legislation

6 Key applicable key legislation with respect to the management of radioactive waste is as follows:

- Nuclear Installations Act 1965 (as amended);[6]
- standard conditions applied to nuclear site licences;[7]
- Health and Safety at Work etc Act 1974;[8]
- Radioactive Substances Act 1993 (RSA93);[9] and
- conditions attached to authorisations under RSA93.

Details of how each of the above applies are given in *Part 2 Radioactive Waste Management Cases.*

7 In England and Wales, radioactive substances regulation was incorporated into the Environmental Permitting Regulations (EPR) on 6 April 2010. EPR 2010 is regulated in England and Wales by the Environment Agency. In Scotland RSA 93 is regulated by the Scottish Environment Protection Agency (SEPA) and in Northern Ireland by the Northern Ireland Environment Agency.

For England and Wales, Environment Agency guidance[14] on the regulation of radioactive substances on nuclear licensed sites has been updated for EPR 2010.

8 Government maintains and continues to develop a policy[11] and regulatory framework which ensures that:

- radioactive wastes are not unnecessarily created;
- such wastes as are created are safely and appropriately managed and treated;
- they are then safely disposed of at appropriate times and in appropriate ways.

9 The fundamental protection objective is to ensure that all disposals of solid radioactive waste to facilities on land are made in a way that protects the health and interests of people and the integrity of the environment, at the time of disposal and in the future, inspires public confidence and takes account of costs.

Other relevant guidance

10 Throughout the UK the Health and Safety Executive's (HSE*) Safety Assessment Principles (SAPs)[12] apply. Two principles defined under the broad heading of, 'Radioactive waste management' and two principles under the broad heading of 'Control of nuclear matter' are particularly applicable to waste storage. The principles are:

- SAP RW.5 states: 'Radioactive waste should be stored in accordance with relevant good engineering practice and in a passively safe condition.'
- SAP RW.6 states: 'Radioactive waste should be processed into a passively safe state as soon as is reasonably practicable.'
- SAP ENM.6 states: 'Storage in a condition of passive safety'.
- SAP ENM.7 states: 'Retrieval and inspection of stored nuclear matter'.

11 For England and Wales, The Environment Agency's Radioactive Substances Regulation Environmental Principles:[13] apply:

- Principle RSMDP10: Storage. Radioactive substances should be stored using the best available techniques so that their environmental risk and environmental impact are minimised and that subsequent management, including disposal is facilitated.
- Principle RSMDP11: Storage in a Passively Safe State. Where radioactive substances are currently not stored in a passively safe state and there are worthwhile environmental or safety benefits in doing so then the substances should be processed into this state.

12 An essential basis for the safety of all facilities for the storage of radioactive waste is set out in the IAEA Safety Standard – Predisposal Management of Radioactive Waste.[14] More facility specific requirements are set out in a report prepared by the Western European Nuclear Regulators' Association (WENRA)[15] , which details safety reference levels (SRLs) for facilities for the storage of radioactive waste and spent fuel.

The above form the basis of this guidance and licensees may wish to refer to the original source if they are unsure as to aspects of this document. More detailed "non-regulatory" guidance that may be useful is listed below.

13 Industry Guidance has been developed on Interim Storage of Higher Activity Waste[16]. The guidance covers the key issues of waste package performance, store longevity, monitoring and inspection regimes, and store maintenance and refurbishment.

14 The Waste Package Specification and Guidance Documentation (WPSGD) produced by NDA Radioactive Waste Management Directorate (RWMD) comprises a suite of documentation that presents their generic packaging standards and specifications at the user level. The WPSGD also includes explanatory material and practical guidance on the storage of waste packages. For further information on the extent and the role of the WPSGD, reference should be made to the WPS/100: Introduction to the Waste Package Specification and Guidance Documentation[17].

* The Office for Nuclear Regulation is, at the time of publication, an Agency of the Health and Safety Executive (HSE) and was created on 1st April 2011. Before then publications were made under the HSE brand.

Guidance on storage of radioactive waste

Fundamental requirement for storage

15 The fundamental requirement in the provision of storage for radioactive waste is that there should be arrangements for safe and secure storage for the anticipated storage period that ensures protection of people and the environment.

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16 Such arrangements may assume a single store to cover the entire period, or may provide for replacement or refurbishments of stores at appropriate intervals.

Storage of unconditioned or raw waste

17 This guidance presupposes that radioactive waste has been conditioned as described in Part 3b of the Joint Guidance, however, this section briefly discusses issues associated with the storage of raw wastes.

18 If raw waste is stored, it should be contained in a manner that avoids deterioration and allows retrieval for processing and eventual disposal, whilst maintaining standards of safety and environmental protection that are as close as is reasonably practicable to those for stored packaged wastes.

19 The physical and chemical state of radioactive wastes accumulated in a raw form that will not be retrieved and packaged until after the plant is shut down can degrade during accumulation. Inspection, typically achieved through direct sampling and analysis of the accumulated waste, should be undertaken where it is reasonably practicable to do so, to confirm that any such degradation will not affect the ability to retrieve and process the waste as planned.

20 Where wastes are stored in unconditioned form, this guidance will need to be applied taking into account the planned future for the waste.

Arrangements for safe and secure storage

21 In all circumstances the following key principles should be applied:

- there will be arrangements for safe and secure storage for the anticipated storage period on the nuclear licensed site concerned that ensures protection of people and the environment; and
- such arrangements should be applied in the context of a suitable programme for managing such wastes to a point where responsibility for the wastes can be discharged through final disposal or suitable alternative storage on another nuclear licensed site.

22 Arrangements for the safe and secure storage of radioactive waste should have regard to:

- passive safety;
- multiple barrier containment to ensure protection of people and the environment;
- the design of storage facilities;
- storage capacity;
- acceptance criteria;
- maintenance;
- inspection and retrieval;
- records.

These are discussed in more detail in the following sections.

Passive safety

Radioactive waste should be stored in accordance with relevant good engineering practice and the requirements of passive safety

23 Passive safety requires radioactive wastes to be in a form that is physically and chemically stable and stored in a manner which minimises the need for control and safety systems. Accomplishment of passive safety covers aspects of both the waste package itself (covered in the guidance module on Conditioning and disposabililty) and in the storage conditions (covered by this part of the guidance).

Passive safety should not be dependent upon active systems, maintenance, and monitoring or human intervention, as far as practicable

24 With respect to the long-term storage of radioactive waste, it is recognised that it may be necessary or advantageous for some active systems to be in place, for example control of environmental conditions within the store. In such cases, the systems should be designed for minimum maintenance, and, in the event of failure, immediate repair/replacement should not be necessary in order to ensure continuing safety of the storage facility and its contents. The extent to which passive safety is required will need to be determined by a balance between the various factors discussed in this guidance document, including safety, relevant good practice, protection of the waste, cost and sustainability.

25 This guidance describes the important features of and requirements for passive safe storage. Proposals for the storage of radioactive waste developed by licensees could include most of the requirements for passive safety set out in the following list, but not necessarily every one. Licensees should demonstrate that any shortfall in meeting the full requirements does not result in any significant safety detriment or compromise the overall aim of passive safe storage.

26 The full requirements for passive safe storage, to minimise the risk that a waste package will require intervention prior to final disposal, are:

- the radioactivity should be immobilised;
- the waste form (as described in the guidance module on Conditioning and disposabililty) and its container should be physically and chemically stable;
- potential energy should be removed from the waste form;
- a multi-barrier approach should be adopted in ensuring containment;
- the waste form and its container should be resistant to degradation;
- the storage environment should maximise waste package life;
- the need for active safety systems to ensure safety should be minimised;
- the need for monitoring and maintenance to ensure safety should be minimised;
- the need for human intervention should be minimised;
- the storage building should be resistant to foreseeable hazards;
- the storage arrangements should be amenable to refurbishment as needed;
- access should be provided for response to accidents;
- there should be no need for prompt remedial action;
- the waste packages should be inspectable;
- the waste packages should be retrievable for inspection, reworking, or disposal;
- the lifetime of the storage building should be appropriate for the storage period prior to disposal;

27 Licensees should aim to apply the requirements for passive safe storage within a framework of reasonable practicability and cost-effectiveness. Regulators interpret this to mean that implementing the requirements for passive safety should be carried out where reasonably practicable but in any case where it

constitutes current relevant good practice and complies with good standards of engineering. Exceptions will need to be substantiated by demonstrating that the costs implementing these requirements would be grossly disproportionate to the safety and environmental benefits.

28 The application of good standards of engineering and modern principles for radioactive waste management, including passive safe storage, is an overarching regulatory requirement. As part of a store's safety case, licensees may employ probabilistic safety assessment methods to demonstrate that the risk from the facility is acceptably low. However, probabilistic safety assessments should not be used to defend non-compliance with current relevant good practice or good standards of engineering.

Multiple barrier containment

A multibarrier approach should be adopted to provide effective containment and protection of the environment

29 Passive safe storage of radioactive materials and radioactive wastes is most appropriately achieved by providing multiple physical barriers to the release of radioactivity to the environment. The physical barriers include the nature of the waste itself, any material that may be used for encapsulation, the waste container (all covered in the guidance module on Conditioning and disposabililty) and the storage building or structure, each of which should be designed to provide effective containment and prevent leakage of radioactive material. The multiple barrier containment provided by the storage building or structure is particularly important in consideration of the storage of unconditioned wastes (eg prevention of leakage to ground of raw waste).

Storage building or structure

The storage building is the outer physical barrier to the release of radioactivity to the environment

30 In aiming to achieve passive safety the most significant barriers are first the waste form itself, and secondly the waste container, with the storage facility providing the final outer physical barrier. In some cases the role of the storage building or structure may be limited to providing suitably protected environmental conditions for storage of waste packages, radiation shielding and presenting a secure boundary against unauthorised intrusion or interference and entry of wildlife. Where safety and protection of the environment is dependent on the performance of the storage building or structure as a barrier, specific design criteria with respect to external hazards, will be relevant (paragraph 50).

31 One of the foreseeable mechanisms for the mobilisation of radioactivity in waste is the ingress and action of water in a store. Potential sources of water ingress are groundwater, rainwater, flooding and condensation. Stores should be located and designed to reduce the potential of water ingress for example by locating the store above ground level. Factors to be considered in the design of a facility for the storage of radioactive waste are discussed further in paragraphs 35–53.

Radiation shielding

32 Adequate shielding of operators and the public against the radiation hazard from the radioactivity in the waste should be provided by a combination of the waste form, the waste container and the storage building or structure. This should be designed and implemented to optimise radiological protection, taking account of normal operation, anticipated operational occurrences and design basis accidents.

Prevention and mitigation of releases of radioactivity to the environment

33 Measures for ensuring the optimisation of radiological protection of the workers, public and environment from the release of radioactivity in normal operation, anticipated operational occurrences and design basis accidents should be designed and implemented. If the long-term storage of radioactive waste will involve the discharge of radioactivity to the environment, for example, gaseous discharges may occur via ventilation systems designed to maintain dry and clean conditions in the store, then such discharges will require disposal authorisation or permitting by the environment agencies.

34 Provision should be made for mitigating the release of radioactivity from the facility in the event of abnormal conditions, for example, by filtration or isolation.

Design of storage facilities

Storage facilities should be designed in accordance with relevant good engineering practice and to enable radioactive waste to be stored in a passively safe condition, taking account of normal and accident conditions

35 The radioactive waste storage facility should be designed on the basis of assumed conditions for its normal operation and assumed incidents or accidents and should fulfil the following fundamental safety functions:

- acceptable sub-criticality margins, where necessary;
- containment of radioactive material;
- optimised radiological protection of operating personnel, the general public and the environment via appropriate shielding and control of the release of any radioactivity;
- adequate arrangements for handling and stacking of waste packages;
- removal of heat, where necessary.

The current design basis should be clearly and systematically defined and documented.

36 As far as is reasonably practicable passive safety features should be incorporated into the design.

37 Structures, systems and components (SSCs) that act as barriers should be provided, to an extent proportionate to the hazards presented to safety and the environment by the stored waste, to limit the consequences of postulated initiating events (PIEs) and to mitigate accident sequences. The design of the SSCs should take account of a list of PIEs consistent with a proportionate approach.

38 Provisions for maintenance, testing and inspection should be established to address the ageing of SSCs and safety features. Results from this programme should be used to review the adequacy of the design at appropriate intervals. (*Note:* This may require design provisions to monitor materials whose mechanical properties may change in service owing to such factors as fatigue (cyclic mechanical or thermal loadings), stress corrosion, erosion, chemical corrosion or radiation induced changes).

39 To maintain the waste and the storage facility in a safe state during operation, operational limits and conditions (OLCs) should be established. These defined OLCs should consider:

- environmental conditions within the store (eg temperature, humidity, contaminants);
- the effects of heat generation from waste;
- potential aspects of gas generation from waste, in particular the hazards of fire ignition, explosion, waste package deformations and radiation protection aspects;

- criticality prevention, covering both each individual waste package as well as the whole store (including operational occurrences and accident conditions).

40 Where waste packages that deviate from the acceptance criteria of the store are required to be placed in storage, specific substantiation for the properties of the waste and its suitability for handling and retrieval over the required storage period should be considered prior to consignment in the store (See Paragraph 60). In particular, changes that might occur over time in the waste and the packages should be considered.

41 The facility should be designed to prevent a criticality accident, considering the criticality relevant parameters during normal operation and fault/accident conditions. As far as reasonably practicable, criticality safety should be achieved by design of the packages used and store rather than by administrative means.

42 Means for removing residual heat during normal operation, anticipated operations, operational occurrences and design basis accidents should be provided where identified as necessary by the safety case.

43 The licensee should make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

The design lifetime of the storage facility should be appropriate for the expected storage period

44 The design of the storage facility should take into account the expected lifetime of the facility to ensure that the safety conditions, and the operational limits and conditions identified in the safety case, will be met. Where the design life of the storage facility does not meet the required storage time for the waste, consideration should be given to replacement or refurbishment of the store and identification of the appropriate intervals for this to be undertaken.

45 The design of the storage building or structure should be fit for purpose, taking into account the expected time required for storage and the hazards posed by the stored wastes, ie the design should be proportionate to the defined purpose of the building and to the risks. If it is proposed that an existing structure, modified in some cases, is used for future long-term storage, it should be demonstrated that, so far as is reasonably practicable, the structure meets current standards, the construction standards and the materials chosen for any modification work are appropriate and the resultant store is safe for the projected period of storage. In some cases a building may be designed for a shorter life with the intention of periodic refurbishment. In these cases, demonstration should be provided that the waste can be stored safely while the refurbishment is carried out.

The storage environment should maximise waste package life

46 The storage building will need to provide sufficient protection to the stored wastes so as to maximise the life of the packages and to facilitate safe transfer to the final disposal facility (or to a further storage facility) at the appropriate time. This may necessitate control and monitoring of the environment of the storage building (temperature, relative humidity and constituents of the atmosphere) in order to minimise package corrosion rates. This may be particularly important on sites that are near the coast where chloride levels in the atmosphere are relatively high. It may not be possible to achieve such environmental control by purely passive means and it may be necessary to adopt a forced ventilation system with control of relative humidity and a filtered inlet to remove atmospheric contaminants such as salts. This is an example of where there may be a need for an active system as opposed to a passive system. It would be expected that such systems would be very reliable, simple, long lived and easily maintained.

Appropriate monitoring systems and alarms should be provided but there should be no requirement for continuous human presence or supervision at the store to ensure safety

47 Monitoring systems and alarms will need to be provided to detect abnormal conditions such as abnormal temperature and relative humidity in the atmosphere of the facility, build up of flammable gases,

water and groundwater ingress, fires and unauthorised intrusions. Where appropriate, alarm systems should be set up to initiate responses at remote locations. A radiation monitoring system would provide the ability to detect radioactivity in liquid or gaseous forms in the event of damaged/deteriorated packages. Groundwater should also be routinely monitored, particularly adjacent to storage facilities for unconditioned wastes. Wherever possible, the panels and electronics associated with the monitoring system should be situated in a radiologically safe area of the building or externally.

48 Ideally, there should be no requirement for continuous human presence or supervision. Human involvement should be limited to confirmatory surveillance, inspections and responding to incidents on a reasonable timescale. However, it would be good practice to provide periodic surveillance and inspection to confirm that the environment within the building is as intended and that the condition of the waste packages is not deteriorating. The building design should include provision for routine inspection, including access to the packages by remote or manual means depending on the radiation levels and the ability to retrieve packages for inspection and remedial action. The possible use of dummy packages and/or corrosion test coupons may be considered to minimise the requirement for movement of waste packages.

49 Although one of the aims of passive safety is to minimise the need for surveillance and inspection to ensure safety, it is expected that periodic inspections will be carried out to confirm that the condition of the waste and its storage are not deteriorating significantly, and to confirm its continuing acceptability for safe storage, and ultimately retrieval, transport and disposal. Inspection will not be restricted to the waste packages but will cover the storage facilities and buildings, and the associated safety arrangements. See later section on waste package monitoring.

The storage building should be resistant to foreseeable hazards

50 The storage facilities should be designed to be resistant to the range of foreseeable internal and external hazards. For external hazards, such as seismic events, flooding and high winds, account should be taken of climate change and other long-term trends such as rising sea levels, changes in groundwater levels, extent of flooding, coastal erosion etc. The multiple physical barriers to the release of radioactivity from the waste should provide resistance to dispersal as a result of foreseeable external and internal hazards, for example, where appropriate, seismic qualification of the storage facility should be considered. More specific guidance on hazards can be found in the Technical Assessment Guides published by the ONR/HSE.[18,19]

51 Storage buildings should include features to monitor for water and groundwater ingress and the means of collecting and removing any water that enters the facility. These features could involve a sloping floor, a collection sump with level alarm and safe facilities to pump out the water and a means of monitoring the water for radioactivity prior to disposal. Any discharge to the environment of water collected from the inside of the store which could have been in contact with radioactive waste will need to be managed in order to minimise radiochemical, and chemical contamination, and entrained solids. Appropriate optimisation techniques will need to be employed to identify and implement the most suitable discharge management systems.

52 Any effects, which would cause deterioration of the waste form, container or storage building over the storage period, should be taken into account including, for example, corrosion or microbiological action.

There should be no need for prompt remedial action following abnormal conditions

53 The design of the storage arrangements should aim to minimise the requirement for prompt remedial action following events and off-normal conditions to mitigate the release of radioactivity. Examples of such provision are filtration and the means to isolate equipment.
Where groundwater ingress into a facility could occur any monitoring plan will need to incorporate appropriate trigger and action levels for groundwater height and quality.

Storage capacity

Reserve storage capacity should always be available

54 It may be necessary to move packages within the storage facility, eg for inspection, retrieval or maintenance work, and reserve storage capacity should always be available for this.

Waste Acceptance Criteria

Waste Acceptance Criteria should be set for the storage facility that include consideration of future disposal requirements or planned management strategies, and arrangements put in place to assure compliance.

55 It is important to ensure that any waste package fulfils all relevant design requirements such as:

- compatibility with handling, transport and storage requirements including suitability for retrieval and transport following the anticipated storage periods;
- known or likely requirements for subsequent disposal or other management aspects included in the owner's waste management strategy such as the need for further treatment or conditioning of the waste.

56 When establishing Waste Acceptance Criteria, storage conditions and compatibility with the facility safety case should be considered, including the suitability of the waste packages for handling and retrieval and onward waste management prior to disposal.

57 Processes and procedures, involving auditing, inspection and testing, should be designed and implemented to ensure that waste packages meet the acceptance criteria for storage when they are received.

58 Before being placed in storage, waste packages should be monitored and cleared for the absence of surface contamination that could otherwise initiate or accelerate corrosion of the package. Suitable arrangements should be available for dealing with any surface contamination that is found.

59 If, during or after storage, it is found that the radioactive waste does not meet the criteria for final disposal then any processing required should be undertaken.

Contingency plans should be prepared for packages that do not meet the acceptance criteria for the storage facility

60 The storage facility should have procedures to deal safely with waste packages that fail the acceptance criteria of the storage facility.

Inspection and maintenance of the storage facilities

Storage facilities should be maintained and inspected.

61 Maintenance, periodic testing and inspection should be undertaken to ensure that Structures, Systems and Components (SSCs) are able to function in accordance with the design intent and safety requirements. This should include both preventative and corrective maintenance.

62 The programme for this maintenance, periodic testing and inspection, which should be based on approved written procedures, should be prepared in advance of storage facility operation. The frequency of maintenance, periodic testing and inspection should be in accordance with the facility safety case. The results of maintenance, testing and inspection should be recorded and assessed.

63 Equipment necessary for on-site emergency plan implementation should be included in the maintenance, periodic testing and inspection programme.

64 Equipment and items used for maintenance, periodic testing and inspection should be identified and controlled to ensure their proper use.

65 Maintenance, periodic testing and inspection programmes should be reviewed at regular intervals to incorporate the lessons learned from experience.

66 The programme of maintenance, periodic testing and inspection should include:

- the monitoring regime for the required environmental conditions within the storage facility;
- the appropriate programme for monitoring the state of the waste packages, as derived from the facility safety case and the ageing of SSCs.
- Groundwater control and monitoring boreholes and groundwater control mechanisms should be included in the inspection and maintenance schedule.

67 Handling equipment should be designed to take account of radiation protection aspects, ease of maintenance and minimisation of the probability and consequences of associated incidents and accidents.

Waste packages monitoring programme

A waste package monitoring programme should be developed and implemented

68 A waste package monitoring programme should be developed and implemented to confirm that waste packages and storage facilities are, and will remain, in an acceptable condition for continuing safe storage, retrieval and final disposal within the limits specified to ensure continued functionality of the safety features on which the safety case is based. The waste package monitoring programme should be adequate to assure the continued compliance of waste packages in line with the safety case requirements.

69 Where it is proposed that only a proportion of the waste packages will be inspected, licensees should demonstrate that the sample is representative or, where appropriate, targeted. A package monitoring programme should take be chosen on the basis of the expected rate of degradation and the perceived risk to the integrity of the containers. It should take into account any high risk packages or areas within a store where the conditions present more risk of degradation of the packages.

70 Performance criteria, against which the condition of the waste is to be assessed, should be developed, for example:

- Container corrosion (external, internal)
- Wasteform expansion (indicator of internal corrosion stress, pressure)
- Loss of package identification
- Lifting feature degradation
- Loss of mechanical strength
- Dose rate change (e.g. indicator of annulus degradation)
- Gas generation (indicator of wasteform evolution)

These performance criteria should specify and substantiate the method and frequency of inspections. The monitoring frequency should allow time for preventative action or additional protection to be put in place.

Remedial action

Remedial action should be implemented for waste packages that show signs of degradation

71 The licensee should have plans to deal with waste packages that show signs of loss of integrity or degradation including the identification of any appropriate materials or equipment, eg additional packaging required, and making it available in due time.

Store design for inspection and retrieval

The storage facility should facilitate the retrieval of all waste packages for inspection, remedial treatment and transfer elsewhere for further storage or final disposal

72 The storage facility design should include provision for routine inspection, including access to the packages by remote or manual means depending on the radiation levels and the ability to retrieve waste packages within an appropriate time for:

- inspection;
- safeguards requirements;
- possible remedial treatment;
- further storage elsewhere; or
- for disposal.

73 Waste handling equipment may not be continuously available, but should be capable of being returned to service when needed and should be maintainable within a radiological safe area either inside or outside the building. Depending on the radiation levels associated with the waste packages, remote handling techniques may be required.

74 Appropriate contingency arrangements should be in place to retrieve waste packages if they cannot be retrieved by the normal means, eg loss of availability of the normal waste handling equipment.

75 Handling, monitoring and inspection equipment should be designed to minimise the damage (eg scratching) and cross contamination (eg of stainless steel with carbon steel) of waste packages.

Records

See the guidance module on managing information and records relating to radioactive waste for detailed guidance on record keeping

76 Licence Condition 32 – Accumulation of radioactive waste requires that records be kept of radioactive waste accumulated on nuclear licensed sites. Licensees are required to make and maintain adequate records of the inventory and management actions associated with the radioactive waste stored. The information contained on these records should include:

- details of packaging**;**
- operational history of processes and stores;
- records of non-compliances with specifications;
- records of any relevant incidents.

Further information is given in the guidance module on managing information and records relating to radioactive waste.

Information and records that might be required now and in the future for the safe management of radioactive waste should be assembled and preserved

77 Storage of radioactive waste in a passively safe form may last for at least 100 years. Comprehensive information and records need to be assembled as part of the storage arrangements. Records should be kept in such a way that sufficient information can be extracted for both current and future needs for each individual waste package. They need to be securely retained and to be accessible when required.

References

1 *The management of higher activity waste on nuclear licensed sites: Part 1 The regulatory process* NRW01 HSE, Environment Agency, SEPA 2009. www.hse.gov.uk/nuclear/wastemanage.htm

2 *The management of higher radioactive waste on nuclear licensed sites: Part 2 Radioactive waste management cases NRW04* HSE, Environment Agency, SEPA 2009 www.hse.gov.uk/nuclear/wastemanage.htm

3 *The management of higher activity radioactive waste on nuclear licensed sites: Part 3b Conditioning and disposability* NRW05 HSE, Environment Agency, SEPA 2009 www.hse.gov.uk/nuclear/wastemanage.htm

4 *The management of higher activity radioactive waste on nuclear licensed sites: Part 3d Managing information and records relating to radioactive waste in the United Kingdom* NRW08 HSE, Environment Agency, SEPA 2009 www.hse.gov.uk/nuclear/wastemanage.htm

5 *The management of higher activity radioactive waste on nuclear licensed sites: Part 3a Waste minimisation, characterisation and segregation N*RW07 HSE, Environment Agency, SEPA 2009 www.hse.gov.uk/nuclear/wastemanage.htm)

6 *Nuclear Installations Act 1965 (c57)* The Stationery Office 1965 ISBN 978 0 10 850216 3

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

8 *Health and Safety at Work etc Act 1974 (c37)* The Stationery Office 1974 ISBN 978 0 10 543774 1

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