

UK Management of Solid Low Level Radioactive Waste from the Nuclear Industry:

Guidance for application of the Waste Management Hierarchy

November 2009

Document History

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Executive Summary

This document provides guidance on Waste Avoidance and Minimisation Good Practice with specific application of the Waste Management Hierarchy (WMH) to the management of Low Level Waste (LLW).

This Guidance has been designed to be deployed as an electronic sign post document for waste managers and others who may be required to contribute to LLW minimisation initiatives. It is the intention of LLWR to modify this document as practices changes and evolve.

The document details the importance of the Waste Management Hierarchy and confirms its central position in LLW waste management.

The document summarises the waste management hierarchy and its relevance to the management of LLW, providing the policy and regulatory context as well as introducing options for management and interaction with other industry tools and techniques. The guidance also discusses management options including the constituent elements of the waste management hierarchy and relevant best practice.

The document has been submitted as Revision 1 as a milestone in the delivery of initiative WAM1; a requirement of the UK Nuclear Industry LLW Management Plan ^[1]. It is the intention that the next iteration will incorporate stakeholder comments.

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1 Introduction

Avoiding the generation of LLW prevents the requirement for future management

1 Introduction

1.1 What does the purpose of this guidance?

The purpose of this guidance is to promote LLW management good practice, including an understanding and application of the Waste Management Hierarchy (WMH). The application of the waste management hierarchy is considered essential to reduce the LLW disposals to the LLWR, long term liabilities and ultimately preserve capacity. Application of the WMH is good practice, will assist NDA sites, save money, and reduce resource usage.

1.2 What does this guidance cover?

This Guidance:

- Describes and emphasises the importance of the waste management hierarchy in waste avoidance and minimisation programmes at NDA sites;
- Describes the policy and regulatory requirements supporting application of the waste management hierarchy at NDA sites;
- Describes possible interaction with other tools and techniques utilised at nuclear sites to minimise waste arisings.

Provides direction to appropriate guidance supporting the implementation of the waste hierarchy and waste minimisation studies.

1.3 Who is this guidance for?

The guidance has been written for all sites that generate or have the potential to generate Low Level Waste and consign this to the LLWR. In particular the guidance is aimed at Waste Managers, facilities managers, and others who may contribute to waste type minimisation studies.

The guidance has also been produced for those organisations supporting the nuclear industry in, for example, a design or decommissioning capacity. It outlines the requirements that may be placed on them.

2 What is the Waste Management Hierarchy?

The principles established in the Waste Management Hierarchy underpin good LLW Management practice

2 What is the Waste Management Hierarchy

2.1 The Waste Management Hierarchy

The Waste Management Hierarchy establishes a hierarchy of management options in context of increasing environmental impact, and is based on the simple premise that it is better to avoid waste generation than to treat or dispose of waste. In the case of LLW, this is more important as the liabilities associated with the management of LLW can be significant.

The principles established in the hierarchy underpin good LLW management practices. Avoiding waste generation is considered a priority, whilst disposal should only be considered as a last resort. By moving up the waste hierarchy sites will save money, minimise raw material consumption, and reduce overall environmental impact. Capacity at the Low Level Waste Repository (LLWR) will also be preserved.

Figure 1 provides an overview of the waste management hierarchy as it applies to low level waste.

Joint regulatory guidance has confirmed that Waste Minimisation is a fundamental principle of radioactive waste management and that the waste management hierarchy is a stepwise approach to achieving this^[2].

2.2 A Life Cycle approach

The Waste Management Hierarchy applies throughout the lifecycle of a facility; during design, construction, operation and decommissioning. Tools and techniques can be applied to ensure the hierarchy is applied at each stage. Whilst not immediately apparent, in many situations the hierarchy is embedded in such activities. Focussing on the top levels of the hierarchy as early as possible in the facility lifecycle will result in optimum benefits.

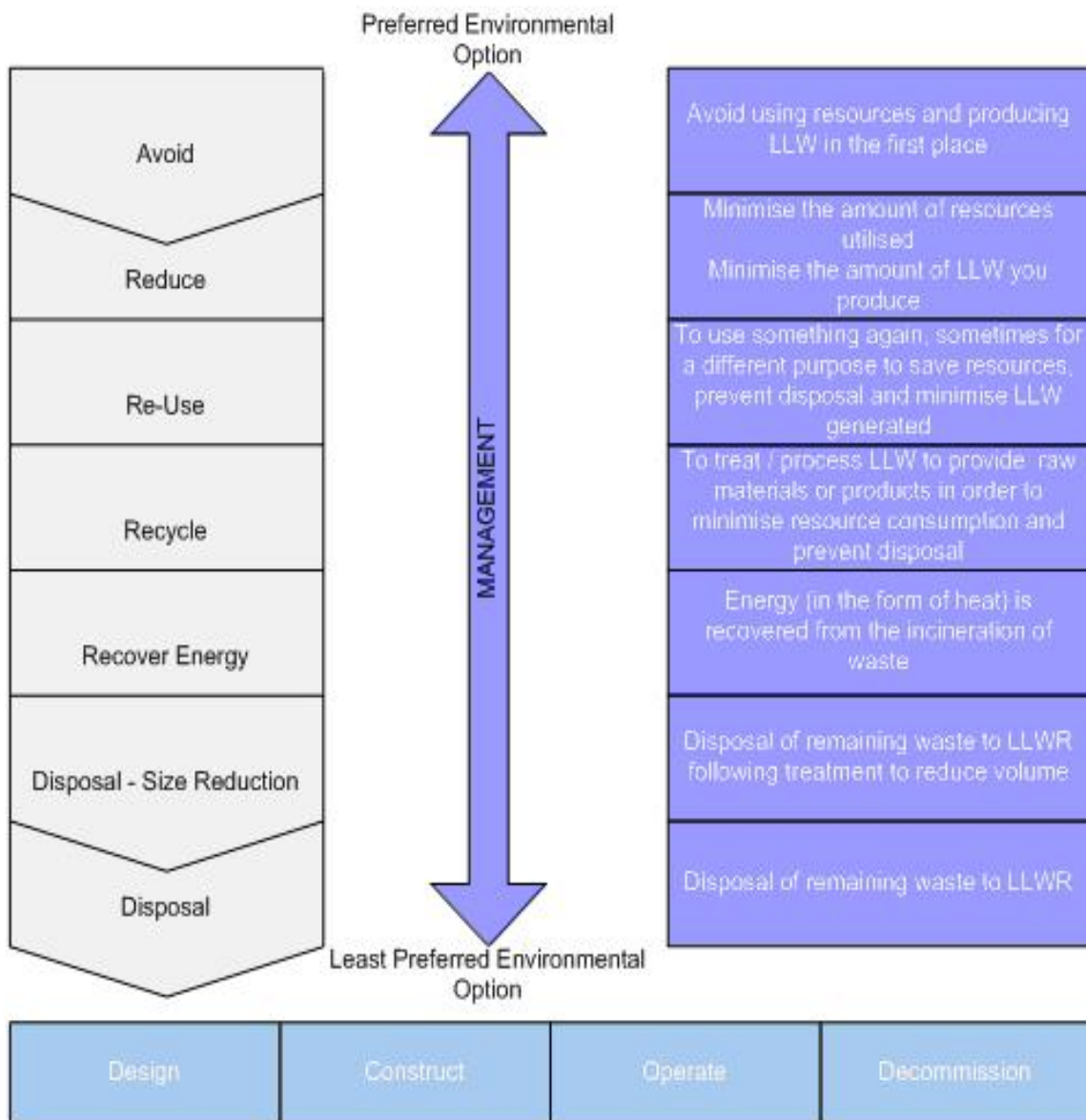


Figure 1 –The Waste Management Hierarchy

3 Policy and Regulatory Framework

The Waste Management Hierarchy is embodied in UK LLW Policy, UK Legal Requirements and supporting guidance and European Directives, and reflects a societal imperative to reduce consumption and minimise waste generation whilst not impeding economic growth – sustainability

3 Policy and Regulatory Framework

3.1 Policy for the Long Term Management of Solid LLW in the UK

The UK policy for the management of Solid Low Level Waste ^[3] establishes the waste management hierarchy as a central theme and states that:

'LLW managers should plan to manage their wastes in accordance with the Waste Management Hierarchy principles established in the UK Waste Strategy documents' ^[4].

The policy states that for LLW implementation of the waste management hierarchy means:

- Not creating waste where practicable;
- Reducing waste arisings by activity and mass to a minimum through the appropriate design and operation of processes and equipment and making effective use of techniques such as waste characterisation, sorting and segregation, volume reduction and surface contamination removal;
- Minimising quantities of LLW requiring disposal through decay storage, re-use and / or recycling, and incineration;
- Disposal.

Waste minimisation through the application of the Waste Management Hierarchy is embedded in UK National Policy.

3.2 UK Nuclear Industry LLW Strategy for the Management of Solid Low Level Radioactive Waste

The UK strategy for the management of Solid Low Level Waste has been issued for consultation ^[5]. This document clearly articulates a vision for the management of LLW through application of the waste management hierarchy:

'The UK strategy for the management of solid low level radioactive waste from the nuclear industry will facilitate continued hazard reduction and decommissioning through application of the waste management hierarchy'.

3.3 Nuclear Installations Act 1965 and Licence Conditions

The HSE enforces the Nuclear Installations Act 1965 (as amended) ^[6]. Supporting the Health and Safety at Work Act 1974 ^[7] this is the principal legislation covering the safety of workers and the general public at nuclear sites in the UK.

36 standard licence conditions (LC) ^[8] are attached to all nuclear site licences. These detail how licensed sites should be managed by the operator.

Whilst a number of licence conditions are relevant to the management of radioactive waste on nuclear licensed sites, it is Licence Condition 32 that is particularly relevant to the waste management hierarchy. LC 32 requires site licensees to establish and implement adequate arrangements to minimise the rate of production and total quantity of radioactive waste and to record such waste.

The Safety Assessment Principles ^[9] reflect site licence condition 32 and place the implementation of the waste management hierarchy at the centre. In particular they require:

- The development and implementation of a strategy for the management of radioactive waste on-site;
- That the generation of radioactive waste should be prevented or, where this is not reasonably practicable, minimised in terms of quantity and activity; in essence application of the waste management hierarchy.

3.4 Radioactive Substances Act 1993 (RSA93)

The Radioactive Substances Act 1993 ^[10] regulates:

- The disposal of radioactive waste to all media (disposal to land, airborne and liquid discharges);
- The transfer of waste between sites, including treatment and disposal facilities.

Authorisations are required for the disposal and accumulation of radioactive wastes and such authorisations prohibit any disposal other than in accordance with the conditions of the authorisation.

Authorisation includes standard statements that require application of concepts embodied in the waste management hierarchy:

'The operator shall use best practicable means to minimise the volume of radioactive waste disposed of by transfer to other premises'

It is important to note that RSA93 will be integrated into the Environmental Permitting ^[11] regime in 2010.

3.5 Environmental Permitting Regulations

Radioactive Substance Regulations (RSRs) have been incorporated into the Environmental Permitting Programme ^{[12],[13],[14]} with the aim of consolidating all environmental permitting under a single regime ^[15]. The following minor changes to the current regulatory regime are envisaged:

- Exemption orders consolidated and risk based limits established;
- Replacement of Best Practicable Environmental Option (BPEO) / Best Practicable Means (BPM) with Best Available Technique (BAT).

BAT is discussed in greater detail in Section 4.

3.6 Nuclear Sector Plan

The second issue of the Nuclear Sector Plan ^[16] was published in July 2009. This document details the environmental objectives against which the nuclear sector will be measured. It reflects the issues that are considered important to both the regulator and the nuclear industry.

The objective established for LLW emphasises the importance of the waste management hierarchy in the management of waste arisings:

Objective - LLW Management: operator will use the waste management hierarchy as much as possible and minimise use of LLWR as a national asset

In this context operators are required to report the % of LLW sent for:

- Reuse or recycling;
- Disposal to other routes other than LLWR (e.g. incineration, HV VLLW to landfill);
- Disposal to LLWR.

3.7 Joint Regulatory Guidance

The HSE, EA and SEPA have developed joint regulatory guidance. This guidance is focussed on the management of higher activity waste and provides useful insight into regulatory priorities and the central role of the waste hierarchy in regulation. Guidance is available in the following areas:

- The Regulatory process ^[17]
- An introduction to the management of higher-level radioactive waste on nuclear licensed sites ^[18]
- Managing information relating to radioactive waste in the United Kingdom ^[19]
- Waste minimisation, characterisation and segregation ^[20]
- Radioactive Waste Management Cases ^[21]

4 Management Approach and Interaction with Other Studies

Adopting a systematic approach to waste minimisation, integrating the waste management hierarchy into existing management systems will ensure the success of waste minimisation programmes. It is critical to understand the following:

- What the waste is
- What the management route for each waste stream is

4 Management Approach and Interaction with Other Studies

All facilities in this study will have to review documentation prior to accepting any waste. The following sections give an overview of the materials and contaminations that can be accepted

4.1 Principles of LLW Management

The Principles of Radioactive Waste Management have been established by the UK regulators:

- Radioactive Substance Regulation Environmental Principles ^[22] ;
- The Safety Assessment Principles ^[23]

These apply to LLW management and have the concept of the waste management hierarchy at their foundation.

In addition both place emphasis on the development of strategy for management as well as highlighting the importance of preventing waste generation and where this is not possible, minimisation.

4.2 Management Approach

A systematic approach to waste management and the application of the waste hierarchy is considered essential to successful programmes. Such approaches may already be incorporated into existing management arrangements, tools and techniques.

Figure 2 summarises a generic management approach to Waste Minimisation and application of the Waste Management Hierarchy. This, in addition to further considerations will be discussed in the following sections.

4.3 Obtain Commitment

Commitment from senior management is essential in order to ensure sufficient resource and time can be allocated to the project. Existing project arrangements may already provide for this; for example through project sponsors.

4.4 Initial Review

An initial review to understand potential waste streams and their significance is recommended. The depth of such studies will depend on a number of parameters including:

- This information may already be available. Existing waste inventories, life time plan strategy documents or similar reviews may have already been completed;
- Site and regulatory priorities;
- The number of waste streams and potential volumes;
- Site hazard and complexity;
- Uncertainty;
- Radiological and chemical toxicity of potential waste streams and sensitivity of receptors;
- Stakeholder concerns;
- Current or proposed site operations and developments.

4.5 Determine Strategy/Approach

The programme / project leadership should determine the most appropriate strategy / approach. It is essential to understand site and study priorities. Sites may operate project management systems and it may be appropriate to utilise these. Whatever systems are already in place the strategy / approach should be documented to a level proportionate to the expected nature and extent of the programme / project. Consideration should be given to:

- Appropriate gates and milestones;
- Interaction with the requirements of existing programmes / projects;
- Interaction with existing site processes; for example design or process hazard review;
- Current site operations and proposed site developments.

Once the strategy and approach is determined, then there is an opportunity to define the scope and the objectives of the study. The objectives and scope are interdependent and should be developed together. Both should be clearly stated to ensure that system boundaries and interfaces are defined and the study team is focussed.

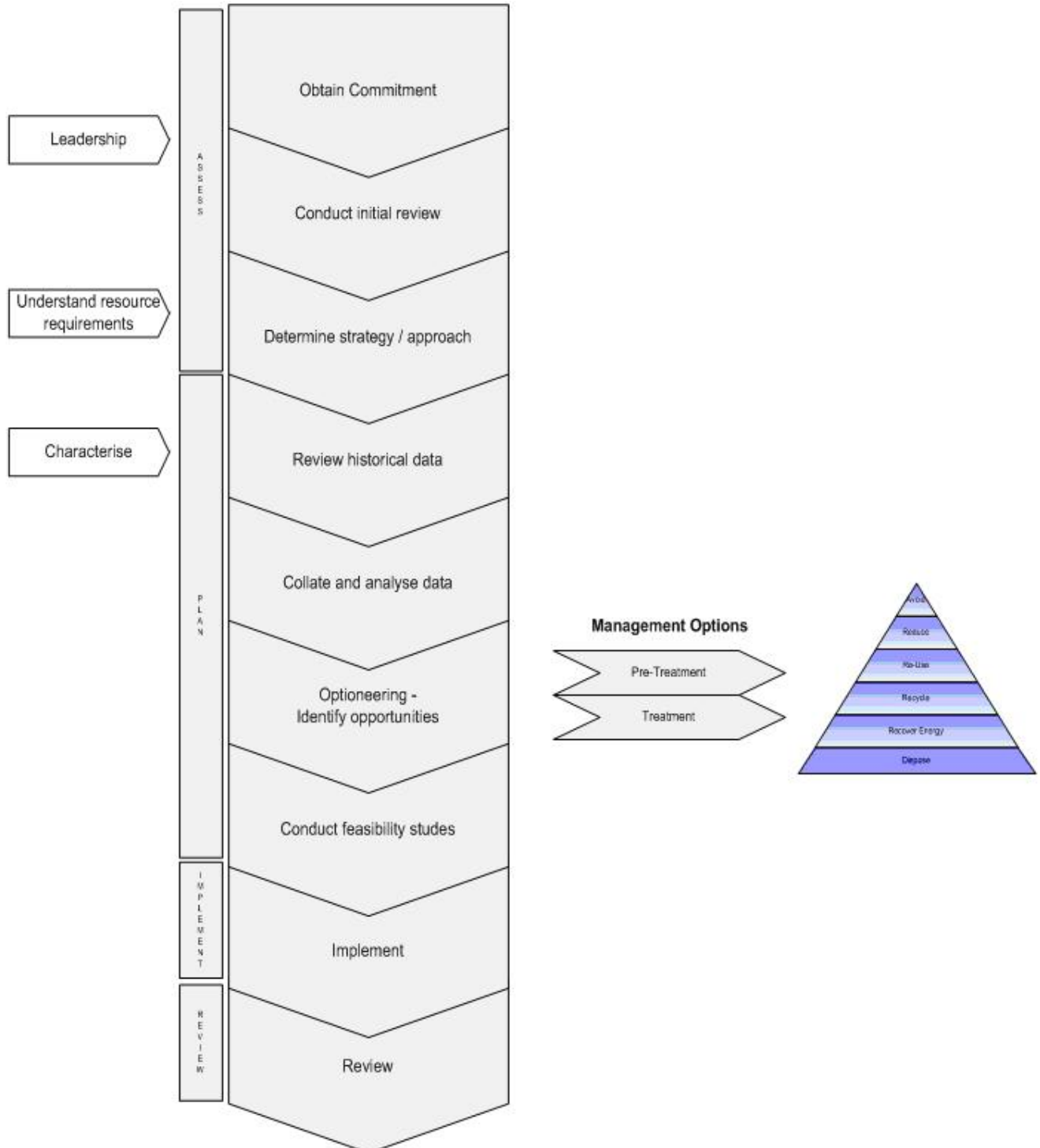


Figure 2 – Management Approach to Waste Minimisation and application of the Waste Hierarchy

4.6 Management Structure and Responsibilities

Waste minimisation initiatives should have a defined management structure with responsibilities clearly understood. Structure and responsibilities should however be proportionate to the study.

Appointment of a programme or project manager should be considered to provide leadership and appropriate authority. A key responsibility of the programme / project leadership would be to ensure that programme / project activities and milestones are understood and developed. Such arrangements may already be established within site project management systems.

Team members (both permanent and temporary) should be clearly identified and their roles and responsibilities understood. Once again team size should be proportionate to the demands of the study. Waste Minimisation studies are team efforts, but the team should be as small as possible whilst containing all the relevant skill necessary to achieve project aims. Suitably Qualified and Experienced Personnel (SQEP) should be utilised with the project leadership ensuring members are appropriate for the study.

Team composition will depend on the nature and extent of the project and stage of the process. Temporary members should be utilised, where appropriate. For example a finance representative may be required if cost benefit analysis is required.

4.7 Identify Opportunities, Decision Making and Action Management

Programme / project arrangements should establish criteria for identifying opportunities and making the most appropriate decisions. Existing site tools and techniques (including BPM, BAT assessments, Life Cycle Analysis etc.) may be utilised but a full understanding of waste stream and waste stream characteristics is essential. The presence of SQEP resources is clearly essential.

For significant opportunities the project team should consider the requirement for feasibility studies.

Managing the actions arising from waste minimisation studies is essential. Consideration should be given to the assignment of specific

responsibility. This may be the project manager or a person assigned by the project manager.

4.8 Implement and Review

In implementing actions the following should be considered:

- Requirements for the implementation; identified opportunities may require significant resource and indeed be a project in itself;
- Systems required to monitor progress including the need for performance indicators;
- Opportunities to integrate into existing site programmes;
- The requirement for pilot studies.

Project / programme review should be considered throughout the lifecycle. It is customary and good practice to complete reviews post project but the following should also be considered:

- Prior to implementation of significant initiatives the validity of supporting data and conclusions should be tested;
- During significant studies to assess progress perhaps in support of milestones.

4.9 Reporting

Within the strategy and arrangements established for waste minimisation and the application of the waste management hierarchy, reporting structures should be clearly defined. Certainly project sponsors, team members and those responsible for action management and follow-up should receive copies of reports.

Consideration should be given to an appropriate communication strategy, and in particular, the provision of information to stakeholders and how to publicise your successes; communicating success should be seen as an excellent opportunity to communicate success and engage others in site waste minimisation programmes.

4.10 Record Keeping

An important strength of adopting a systematic management based approach to waste minimisation is that it will provide the basis for a properly documented study.

Record keeping is an important consideration in radioactive waste management and indeed an essential element of a number of the tools and techniques supporting such activities. Record keeping in this context is often a legal requirement. For example the SAP's specifically require that information that might be required now and in the future for the safe management of radioactive waste should be recorded and preserved ^[24]. Records are essential to comply with Duty of Care ^[25] requirements and should certainly be retained, including those supporting characterisation, transport, consignment, and exemption (in the case of recycled materials).

Record keeping should be proportionate but may include:

- the process documented in sufficient detail to support the completion of the study;
- Minutes of meetings;
- Reporting supporting feasibility studies etc;
- Sufficient information to support the study conclusions remembering that proposed initiatives may have both legal (including safety case) implications as well as supporting business case submissions. Conclusions should be supported and defensible;
- Security aspects where necessary.

Record keeping is an essential component of other environmental management techniques including BPEO, BPM and BAT.

It is also considered essential to monitor waste management performance. In this context an understanding of programme is essential and records may then provide information to support reporting.

BAT implies application of the waste management hierarchy and in particular the submission should contain sufficient information to demonstrate how the operator has, or is proposing to:

- Prevent the unnecessary creation of waste or discharges;
- Minimise waste generation and;
- Minimise the impact of discharges on people and the environment.

4.11 Quality Assurance (QA)

The majority of sites operate quality management systems and the principles and arrangements established in such systems can be applied to waste minimisation and associated studies.

It would be good practice to establish QA arrangements for waste minimisation programmes and / or studies; clearly such arrangements should be proportionate and may be documented. Consideration should be given to the following:

- Quality objectives;
- Terms of reference;
- The requirement for quality plans;
- Arrangements for checking and approval documentation;
- Data validation and verification;
- Document control procedures;
- Arrangements for internal audit.

4.12 Interactions With Other Strategies, Tools and Techniques

4.12.1 Introduction

Operators will already apply a number of strategies, tools and techniques in response to the various requirements placed on a site. Such activities are often complementary to the waste management hierarchy and will include:

- BPEO / BPM Assessment;
- Best Available Techniques;
- Integrated Waste Strategies;
- Environmental Management Systems;
- Business case and NDA value framework;
- Safety case.

4.12.2 BPEO /BPM ^[26]

BPEO and BPM are concepts well established in the nuclear industry to help guide and inform waste management decision making.

Best practicable environmental option originates from the reports Royal Commission on Environmental Pollution (RCEP) and formed the basis of the Integrated Pollution Control Regime during the 1990's (Department of Environment). The RCEP (1988) defined BPEO as:^[27]

‘A BPEO is the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long-term as well as the short term’

and requires the operation of the selected option to ^[28]

‘minimise as far as practicable, the releases of radioactivity to the environment whilst taking account of a wider range of factors, including cost-effectiveness, technological status, operational safety, and social and environment factors’

RCEP (1988) further stated that the BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or the least damage to the environment as a whole, at acceptable cost.

Application of BPEO requires the systematic and balanced assessment to identify options that is not only practicable and regulatory compliant but also maximise the environmental, economic and social benefits. BPEO recognises that for each plan or each element of a plan there is a range of options. Each of these options has a range of impacts. The preferred option is the one which provides the most benefit and / or the least damage; termed Best Practicable Environmental Option.

Evaluating options can be quite complex as options may have a range of benefits and detriments. The identification and justification of BPEO therefore often requires a thorough understanding of each option, including the importance of any impacts, as well as transparency in approach; the decision making process must be fully understood by all

participants. In common with other decision making techniques BPEO may draw upon the result of other studies to fully understand the benefits and detriments of each option. Once the option is chosen this will be tested through, for example, the planning process and specific impact assessments etc..

The BPEO methodology was described by the Royal Commission on Environment Pollution (1988) in their 12th Report ^[29]. It comprises 7 stages with a requirement to maintain an audit trail at each stage:

- Define the objectives;
- Generate options;
- Evaluate the options;
- Summarise and present the evaluations;
- Select the preferred option;
- Review preferred option;
- Implement and monitor.

The BPEO methodology is reliant on the careful and diligent evaluation of technical information. Comprehensive data sets for each criterion can improve the accuracy of the final decision its use has a disadvantages particularly to a lay audience.

The Environment Agency has developed guidance in support of the Assessment of Best Practicable Environmental Option:

- Guidance for the Environmental Agencies' Assessment of Best Practicable Environmental Option Studies at Nuclear Sites ^[30]

The requirements of the waste management hierarchy should be fully integrated into BPEO studies. The NDA has previously summarised how the waste management hierarchy ^[31] can be integrated into BPEO studies and illustrated the preference for moving from gaseous discharges to liquid discharge to solid waste disposal whilst applying the hierarchy to each.

The LLWR has completed strategic BPEO's to support the development and implementation of new treatment and disposal routes:

- Metallic Waste ^[32]
- Combustible Waste ^[33]
- Very Low Level Waste ^[34]

Current guidance suggests that where national BPEO studies exist then these may be applied in the absence of site specific assessments (where appropriate) or used to support site specific assessments.

BPM can be considered in terms of optioneering; it adds further detail to a chosen BPEO. BPM was defined in Cm 2919^[35] as:

“Within a particular waste option, the BPM is that level of management and engineering control that minimises, as far as practicable, the release of radioactivity to the environment whilst taking account of a wider range of factors, including cost effectiveness, technology status, operational safety and social and environmental factors”.

4.12.3 Best Available Techniques (BAT)

The concept of BAT is being introduced into Radioactive Substance Regulation. In England and Wales it will replace BPEO / BPM. The EA considers BAT to have the same meaning as the

use of BPM/BPEO and requires the same approach as previously set out in the Royal Commission on Environmental Pollution definition of BPEO^[36].

BAT embodies the principles underpinning the waste management hierarchy. Figure 3 summarises this interaction; BAT can be considered in terms of unavoidable waste creation and unavoidable waste discharge and these can be aligned to the waste management hierarchy. Sites will be required to demonstrate BAT and in doing this formal consideration of the waste management hierarchy is advised. In understanding whether more can be done to prevent and minimise environmental impacts associated with identified BAT, opportunities to reduce, recycle and recover energy associated with wastes streams should also be considered. It is the position of LLWR that this requirement should be embodied in procedures. The Environment Agency is producing guidance supporting the Radioactive Substance Regulation Environmental Principals (REP's)^[37] that are directly and indirectly relevant to the application of BAT. Table 1 summarises the guidance.

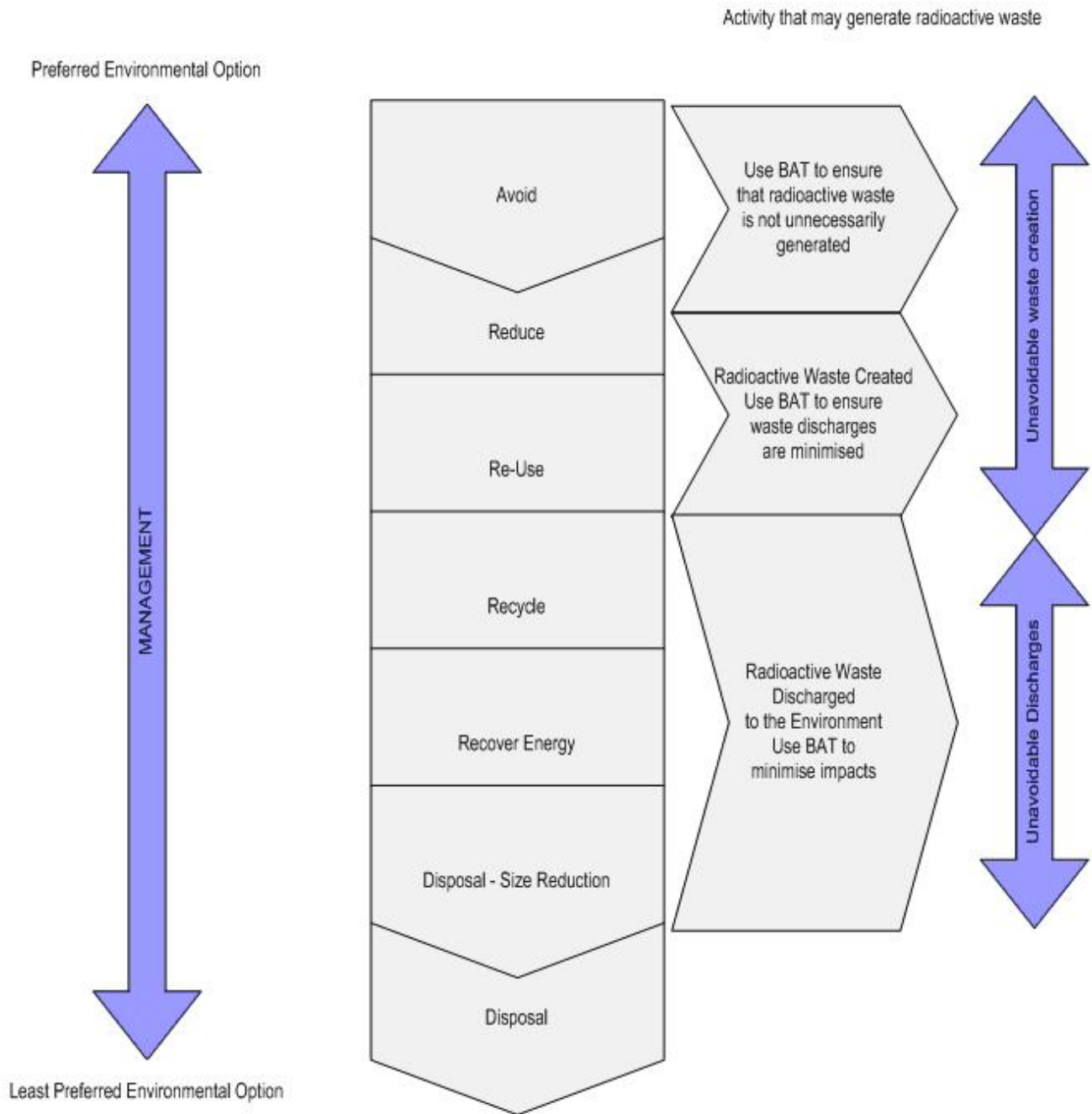


Figure 3 – Application of Waste Management Hierarchy to BAT ^[38]

Table 1 – Summary of Guidance Supporting BAT

Radiological protection	
RPDP1	<p>Optimisation of protection: <i>all exposures to ionising radiation of any member of the public and of the population as a whole shall be kept as low as reasonably achievable (ALARA), economic and social factors taken into account.</i></p> <p>With regard to wastes, compliance <u>with ALARA should be achieved by applying BAT.</u></p>
Radioactive Substance Management	
RSMDP3	<p>Use of BAT to minimise waste: <i>best available techniques should be used to ensure that the production of radioactive waste is prevented and where that is not practicable, minimised with regard to activity and quantity;</i></p> <ul style="list-style-type: none"> ◆ Processes creating, handling, treating and storing radioactive materials should be identified and optimised so as to prevent or minimise the production of waste over the <u>complete lifecycle</u> of the facility; ◆ That optimisation should be undertaken as part of a waste strategy and use <u>options studies</u>, particularly for new or changing facilities; <p>Processes producing radioactive waste should be <u>reviewed at intervals</u>, to identify opportunities to further minimise waste production;</p>
RSMDP4	<p>Processes for identifying BAT: <i>the best available techniques should be identified by a process that is timely, transparent, inclusive, based on good quality data, and properly documented;</i></p>
RSMDP5	<p>Actions having irreversible consequences: <i>actions with radioactive consequences having irreversible consequences should only be undertaken after thorough, detailed, consideration of the potential consequences of those actions and of the other available options. The best available technique should be used to prevent irreversible consequences from occurring inadvertently.</i></p>
RSMDP6	<p>Application of BAT: <i>in all matters relating to radioactive substances the 'best available techniques' means the most effective and advanced stage in the development of activities and their methods of operation;</i></p>
RSMDP7	<p>BAT to minimise environmental risk and impact: when making decisions about the management of radioactive substances, the best available techniques should be used to ensure that the resulting environmental risk and impact are minimised.</p>
RSMDP10	<p>Storage: <i>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.</i></p>
RSMDP13	<p>Monitoring and assessment: <i>the best available techniques, consistent with relevant guidance and standards, should be used to monitor and assess radioactive substances, disposals of radioactive wastes and the environment into which they are disposed.</i></p>

4.12.4 Integrated waste strategy

The requirement for waste strategies is embedded in UK policy and regulation and should cover all wastes, both radioactive and non-radioactive, their on-site management and disposal to all media. The NDA has established a specification supporting the development of such documents:

- Companion Document to Integrated Waste Strategy Specification ^[39]

4.12.5 Environmental Management Systems

The majority of nuclear sites operate an environmental management system. This may stand alone or more usually be integrated into the wider business management processes. It may or may not be certified to BS EN ISO 14001:2004. Such systems provide the framework for managing environmental responsibilities. It may be that arrangements already exist for waste minimisation within an EMS; but certainly these will provide the basis for establishing and managing objectives and targets, communication, audit and review.

4.12.6 Business Case and the NDA Value Framework

The production of business cases to support projects is a fundamental requirement placed on the NDA by government. The NDA has produced guidance ^[40] supporting the production of business case development. The business case process requires options evaluation using the NDA Value Framework. Whilst the values framework does not explicitly identify the waste management hierarchy as an attribute or metric, radiological discharges are considered in the value framework.

The LLWR considers that it would be good practice to evaluate options against the waste hierarchy in this context, thus embedding regulatory and societal requirements in the business case optioning process.

4.12.7 Safety Case

LC 23 ^[41] requires an operator of a nuclear site to develop a safety case. The case justifies the safety of the facility throughout its lifecycle ^[42]. In producing the safety case, the authors will consider the hazards associated with radioactive waste and perhaps arrangements established to prevent and minimise.

Such documents may provide important information related to waste streams and management arrangements. However, perhaps more importantly they may provide a forum for implementing the waste management hierarchy; in practical terms the objectives are not dissimilar.

4.12.8 Managing interactions with other studies

It is recommended that any programme / project for waste minimisation should have knowledge of other relevant studies being completed on-site. This will avoid duplication of effort and involvement by those involved in waste minimisation may indeed add value. A coordinated waste minimisation programme would clearly be advantageous in these circumstances. It is entirely possible that site integrated waste strategies and plans can be utilised in this context.

Formal integration of the requirements of the waste management hierarchy into site procedures is recommended.

4.12.9 Interactions with stakeholders and regulators

Stakeholders and regulators clearly have an interest in waste management initiatives at nuclear licensed sites. This provides an additional rationale for adopting a systematic approach. The requirement for and development of a strategy for engagement should be considered carefully within the framework established for waste minimisation on-site.

It is certainly common practice to consult on certain site based initiatives. For example the strategic LLW BPEO assessments were subject to consultation as were the similar initiatives instigated by Sellafield Ltd. ^[43].

5 Waste Hierarchy Management Options

Management options are available to meet the requirements of the waste management hierarchy; do not re-invent, innovate. Sites must determine how they are most able to identify, adopt and implement. Management arrangement and facilities must reflect the demands of the Waste Management Hierarchy

5 Waste Hierarchy Management Options

5.1 Introduction

We have already discussed the importance of a structured approach to waste minimisation perhaps utilising existing tools and techniques already embedded within your organisation.

The identification of practical opportunities to prevent and minimise waste generation and the application of the waste hierarchy is an element in this approach. These have been termed waste hierarchy management options for the purpose of this guidance.

Figure 4 summarises the waste hierarchy management options and essential precursors to the successful implementation of these options.

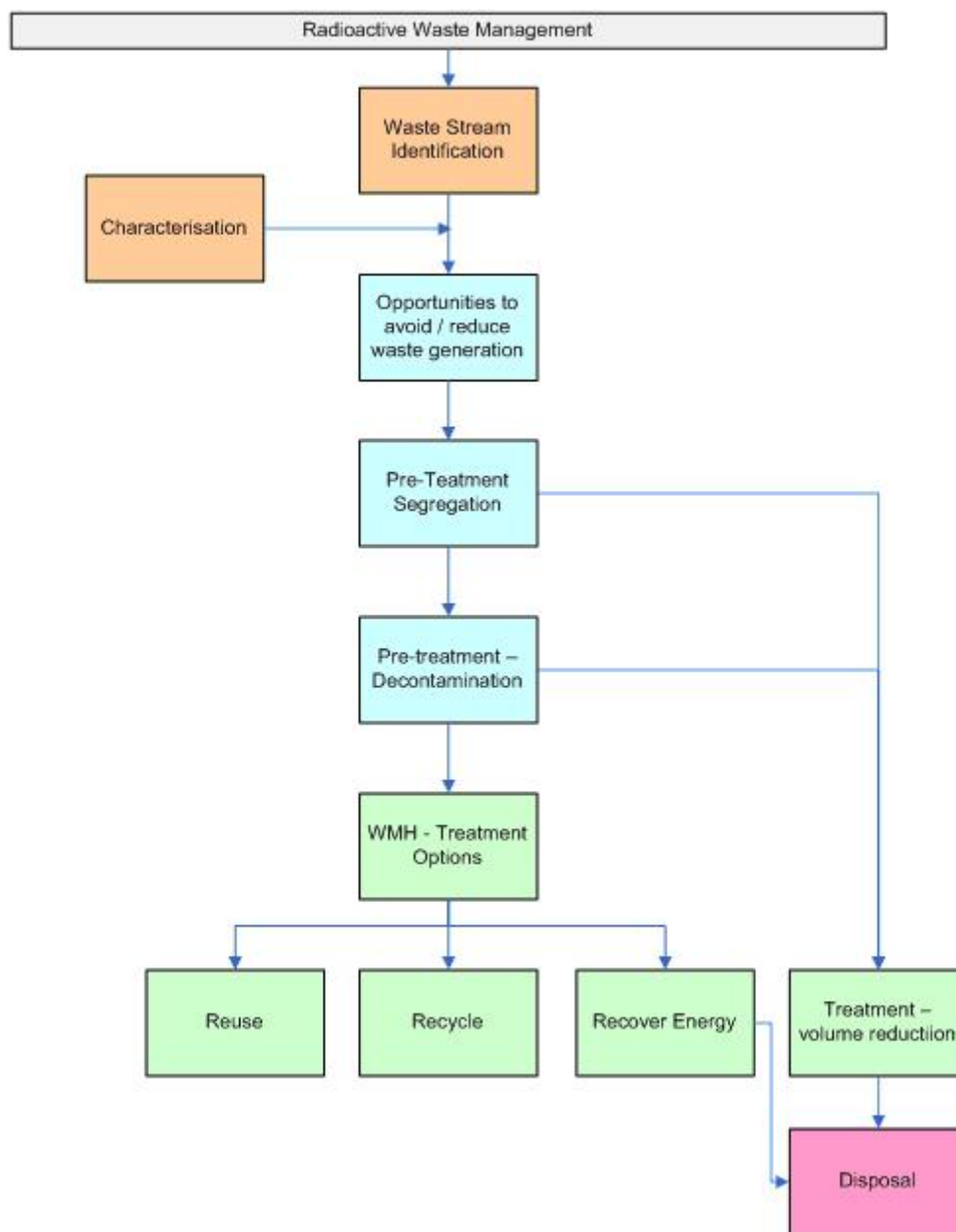


Figure 4 – Radioactive Waste Hierarchy Management Options ^[44]

5.2 Characterisation

Characterisation is defined by the IAEA ^[45] as the 'determination of the physical chemical and radiological properties of the waste to establish the need for further adjustment, treatment or conditioning, or its suitability for further handling, storage or disposal'.

Characterisation of radioactive waste is central to effective radioactive waste management and application of the waste management hierarchy. Understanding the properties of a waste stream will enable correct waste management hierarchy choices to be made. Such activities should be completed at an early stage to support optioneering. Care should also be taken to avoid unnecessary over characterisation ^[46].

The following guidance is available on characterisation:

- The management of higher activity radioactive waste on nuclear licensed sites; waste minimisation, characterisation and segregation ^[47]
- Clearance and exemption principles processes and practices for use by the nuclear industry ^[48]
- Strategy and methodology for radioactive waste characterisation ^[49]

5.3 Pre-treatment

Pre-treatment describes any or all operations prior to waste treatment, such as collection, segregation, chemical adjustment, and decontamination.

Segregation is an activity where types of waste or materials (radioactive or exempt) are separated on the basis of radiological, chemical and / or physical properties to facilitate waste handling and / or processing

Joint guidance on segregation has been provided by the HSE, EA and SEPA:

- The Management of higher activity radioactive waste on nuclear licensed sites, Waste minimisation, characterisation and segregation ^[50]

Successful LLW management is dependant on segregation and sites should consider the facilities they have available to carry out such activities.

Decontamination is the complete or partial removal of contamination by a deliberate physical, chemical or biological process. The following guidance is available:

- Technical Report Series No 395, State of the Art Technology for Decontamination and Dismantling of Nuclear Facilities ^[51]

It is the EARWG database that perhaps provides the most comprehensive compilation of pre-treatment techniques:

Environment Agencies Requirements Working Group (EARWG) Waste Minimisation Data base ^[52]

5.4 Treatment

Treatment Operations ^[53] benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are available:

- Volume reduction;
- Removal of radionuclide from the waste;
- Change of composition.

It is in this context that the waste management hierarchy can be discussed ^[54]

The following guidance is available:

- Environment Agencies Requirements Working Group (EARWG) Waste Minimisation Data base ^[55]

The EARWG has also established a webpage to identify and share good practices in re-use and recycling solid radioactive waste consistently across the nuclear industry.

6 Implementing the Waste Management Hierarchy

6 Implementing the Waste Management Hierarchy

Table 2 – Priorities for Successful Waste Minimisation

1	Gain commitment	Obtain commitment from site senior management to waste minimisation programmes and the integration of the waste hierarchy into site arrangements. Waste Minimisation is a Win-Win proposition.
2	Establish strategy	Establish a coordinated strategy for waste minimisation ensuring opportunities to gain value from application of the waste hierarchy is integrated at every opportunity.
3	Establish Leadership	Establish responsibility for the waste minimisation programme. In particular, leadership should be considered as well as coordination of all waste minimisation initiatives and employees / stakeholders engagement initiatives on-site.
4	Determine priorities	The site may already have waste management priorities: consider these before embarking on LLW minimisation initiatives. Review existing Integrated Waste Strategies.
5	Establish and integrate management arrangements	Establish a systematic approach to waste minimisation and the application of the waste management hierarchy. Establish management arrangements, integrated into existing business management systems where appropriate. Utilise other initiatives on-site and integrate into a coherent strategy for LLW management.
6	Embed and employ	Formally embed the waste management hierarchy into other tools and techniques used at your site. Training and awareness initiatives should be considered a priority to facilitate this.
7	Establish Facilities and waste routes	Facilities need to be in place to manage waste in accordance with the Waste Management Hierarchy. In particular, areas for segregation and storage may be required. As opportunities to implement the waste management hierarchy arise they may utilise new waste routes. The site RSA authorisation will require modification to reflect such opportunities. Careful planning and discussion with the site regulatory bodies will be required. This should not however be considered a barrier to progress, and regulators will be supportive.
8	Do not re-invent, innovate	Use existing tools, techniques and management options. Do not re-invent the wheel and seek to learn from the experience of others. However, innovate where possible and appropriate.
9	Review performance	Fully commit to continually improving your waste minimisation programmes by fundamentally reviewing success and failure.
10	Report progress and success	Create a culture of involvement and engagement by publicising success flowing from waste minimisation and other related programmes at your site.

Appendix 1 - Glossary

As Low As Reasonably Achievable (ALARA)

The ALARA principle is contained in the Euratom Basic Safety Standards Directive 96/29, which is transposed into UK law. Essentially, it means that all reasonable steps should be taken to protect people. In making this judgement, factors such as the costs involved in taking protection measures are weighed against benefits obtained, including the reduction in risks to people and the environment.

Best Practicable Environmental Option (BPEO)

In the context of authorisations under RSA93, for nuclear sites, the options' assessment method currently used is Best Practicable Environmental Option (BPEO). BPEO was described by the Royal Commission on Environmental Pollution, Twelfth Report (Cm 210) 1988 as "... the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long-term as well as in the short term". A BPEO study is usually carried out by or on behalf of the waste producer and assessed by the relevant environment agency as a basis for its regulatory decision-making.

Best Practicable Means (BPM)

BPM is a term used by the environment agencies (EA and SEPA) in authorisations issued under the RSA93. Essentially, it requires operators to take all reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposal of radioactive waste, so as to achieve a high standard of protection for the public and the environment. BPM is applied to such aspects as minimising waste creation, abating discharges, and monitoring plant discharges and the environment. It takes account of such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals. If the operator is using BPM, radiation risks to the public and the environment will be ALARA.

Command 2919 (Cm2919)

The Review of Radioactive Waste Management Policy: Final Conclusions White Paper published in July 1995. This was the last comprehensive UK Government radioactive waste policy statement. Areas of this statement have been superseded by the decisions and actions of subsequent UK Government administrations.

Contamination

Radioactive substances on surfaces or within solids, liquids or gases (including the human body) where their presence is unintended or undesirable or the process giving rise to their presence in such places

Characterisation

Determination of the physical chemical and radiological properties of the waste to establish the need for further adjustment, treatment or conditioning, or its suitability for further handling, storage or disposal

Decontamination

The complete or partial removal of contamination by a deliberate physical, chemical or biological process

Disposal

In the context of solid waste, disposal is the emplacement of waste in a suitable facility without intent to retrieve it at a later date; retrieval may be possible but, if intended, the appropriate term is storage. Disposal may also refer to the release of airborne or liquid wastes to the environment (i.e. emissions and discharges).

Environment Agency (or EA)

The environmental regulator for England and Wales. The Environment Agency's role is the enforcement of specified laws and regulations aimed at protecting the environment, in the context of sustainable development, predominantly by authorising and controlling radioactive discharges and waste disposal to air, water (surface water, groundwater) and land. In addition to authorisations issued under the RSA93, the EA also regulates nuclear sites under the Pollution Prevention and Control Regulations and issues consents for non-radioactive discharges.

Exemption Order (EO)

RSA93 makes provision for certain low activity wastes, when used for certain purposes and when managed in particular ways, to be excluded from particular regulatory provisions made under the Act.

Health and Safety Executive (HSE)

A statutory body whose role is the enforcement of work related health and safety law under the general direction of the Health and Safety Commission established by the Health and Safety at Work Act 1974. HSE is the licensing authority for nuclear installations. The Nuclear Safety Directorate of HSE exercises this delegated authority through the Nuclear Installations Inspectorate (NII) who are responsible for regulating the nuclear, radiological and industrial safety of nuclear installations UK wide.

Low Level Waste (LLW)

Includes metals, soil, building rubble and organic materials, which arise principally as lightly contaminated miscellaneous scrap. Metals are mostly in the form of redundant equipment. Organic materials are mainly in the form of paper towels, clothing and laboratory equipment that have been used in areas where radioactive materials are used – such as hospitals, research establishments and industry. LLW contains radioactive materials other than those acceptable for disposal with municipal and general commercial or industrial waste. It is now defined as "radioactive waste having a radioactive content not exceeding four gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma radioactivity".

Low Level Waste Repository (LLWR) near Drigg

The LLWR is in Cumbria and has operated as a national LLW disposal facility since 1959. Wastes are compacted and placed in containers before being transferred to the facility. Following a major upgrade of disposal operations in 1995, all LLW is now disposed of in engineered concrete vaults. The LLWR near Drigg is owned by the NDA and currently operated by a consortium of companies called UKNWM.

Nuclear Decommissioning Authority (NDA)

The NDA was set up on 1 April 2005, under the Energy Act 2004. It is a non-departmental public body with designated responsibility for managing the liabilities at specific sites. These sites are operated under contract by site licensee companies. The NDA has a statutory requirement under the Energy Act 2004, to publish and consult on its Strategy and Annual Plans, which have to be agreed by the Secretary of State and the Scottish Ministers.

Nuclear Installations Act 1965 (NIA65)

UK legislation which provides for the operation and regulation of nuclear installations within the UK.

Nuclear Installations Inspectorate (NII)

See Health & Safety Executive

Pre-treatment

Any or all operations prior to waste treatment, such as collection, segregation, chemical adjustment and decontamination

Radioactive waste

Any material contaminated by or incorporating radioactivity above certain thresholds defined in legislation, and for which no further use is envisaged, is known as radioactive waste. (See RSA93 and NIA65.)

Radioactive Substances Act 1993 (RSA93)

UK legislation which provides for regulation of the disposal of radioactive wastes, including liquid and gaseous discharges to the environment. It also provides for regulation of the accumulation of radioactive wastes on non-nuclear sites: this function for licensed nuclear sites being provided by the NIA65.

Segregation

An activity where types of waste or materials (radioactive or exempt) are separated on the basis of radiological, chemical and / or physical properties to facilitate waste handling and / or processing

Strategic Environmental Assessment (SEA)

SEA refers to the type of environmental assessment legally required by EC Directive 2001/42/EC in the preparation of certain plans and programmes. The authority responsible for the plan or programme must prepare an environmental report on its likely significant effects, consult the public on the report and the plan or programme proposals, take the findings into account, and provide information on the plan or programme as finally adopted.

Treatment

Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are:

- Volume reduction
- Removal of radionuclide from the waste
- Change of composition

Waste producer

The organisation that produced radioactive waste in the first instance. The waste producer may or may not equate to the current waste manager, as responsibility for the waste may have been passed to another organisation in the interim.

Appendix 2 - References

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