Nuclear Decommissioning Authority

Integrated Waste Management

Overview
December 2009

Integrated Waste Management v1.0
EDRMS No: 3.18-2 [SMS/TS]
Doc ID: 11636153

Contents

1.0 Foreword

The Nuclear Decommissioning Authority (NDA) has responsibilities for the effective management of radioactive waste within its UK-wide estate. Government has also made us responsible for developing and implementing United Kingdom (UK) wide strategy for nuclear industry low level waste (LLW) and for implementing geological disposal of higher activity waste (HAW), which extends our responsibility outside our own estate in these areas.

The achievement of risk reduction by waste retrieval and immobilisation is our chief priority. However, we also have wider responsibilities to secure optimum waste management practice in terms of safety, environmental protection, security and value for money.

This document sets out our strategy for management of radioactive waste. We seek to take a coherent estate-wide and UK-wide approach to NDA operations, and intend that our integrated waste strategy (IWS) achieves that aim and that it complements the integrated waste strategies that are produced on a site-by-site basis.

The production of this document, together with other waste strategy work, addresses a commitment made in our 2006 published Strategy (page 9) to develop a National IWS. We have developed our thinking since 2006, working initially with the Waste Issues Group, an offshoot of our National Stakeholder Group. We have taken the advice of regulators, waste producers and many others in preparing the strategic framework expressed here. Our detailed waste strategies are developed at 'topic' level under NDA's strategy management system (SMS), so we have kept the present document at a high level. During 2009/10 we have progressed our new initiative to realign NDA's business to match a set of defined 'strategic objectives'. This emergent operating environment for NDA has been reflected here.

Our overall programme of environmental restoration, as reflected in current site plans, runs until after year 2120. Our current aim is that many of the step-changing activities to reduce hazard and implement waste solutions will be achieved by 2020 or within a few years of this date.

Our first major release of draft waste strategy for consultation was our UK Nuclear Industry LLW Strategy (May 2009). This, together with the IWS and our more detailed topic strategies, informs the next NDA strategy to be published in 2011. We look forward to further engagement with all our stakeholders regarding the LLW Strategy, this high level overview and the other individual waste topic strategies as they are launched.

Phil Davies
Head of Waste & Nuclear Materials

2.0 Our Role

2.1 Introduction

The NDA has a leading role in the management of radioactive waste in the UK. Radioactive waste is present at all of our sites. It needs to be managed safely, securely, with due regard to protection of the environment and in a manner that provides value for money for the taxpayer. Government has also given us UK-wide responsibilities for some important aspects of radioactive waste management that extend beyond our own estate. Our role is described in Appendix 1.

This document describes the waste management strategy context applicable to our estate, extending to coverage of the wider UK picture where we have relevant responsibilities. It reflects issues highlighted in site-level IWSs as well as outcomes of our numerous interactions with Government departments, industry regulators, site operators, international organisations, specialist companies in the supply chain and our stakeholder community, for example via the NDA National Stakeholder Group.

2.2 NDA strategy management system

We undertook to produce a National IWS in our published 2006 Strategy. Since then we have devised and launched our SMS, which includes estate-wide coverage of individual topics. Within the SMS there are three individual waste topic strategies under the theme of integrated waste management:

- Higher activity waste (HAW): covering intermediate level waste (ILW) and high level waste (HLW) issues.
- Lower activity waste (LAW): covering LLW.
- Non-radiological and hazardous waste.

Each topic includes individual ‘strands’ that address individual waste groups or issues.

The present document, together with the three waste topic strategies, makes up NDA’s IWS as it stands at the end of 2009. It focuses on management of radioactive waste. Other relevant topics within the SMS are:

- Land quality management: management of contaminated ground and groundwater entails addressing waste issues.
- Cleanup and decommissioning prioritisation: effective waste management is central to NDA’s cleanup and decommissioning mission.
- Plutonium: some or all of the UK civil stocks of plutonium might eventually be designated as waste.
- Uranium: some holdings of uranic materials are likely to be considered as waste.
- Oxide fuel: some used oxide reactor fuel not reprocessed might eventually be designated as waste.
- Research and development (R&D): much of the programme relates to addressing waste management and technology opportunities
- Transport and Logistics: waste management entails transfers of waste (for treatment, storage and disposal purposes) using the public transport system.

This document provides context for the SMS topic level work, and as such it avoids reproducing the detail developed at the topic level. Together these documents will inform the next NDA Strategy, to be published in 2011. Current work in NDA is to develop the topic strategies through a gated approval process and to lift key points of waste management strategy from the topics into a new theme level summary. This

will go through stages of development to provide material for NDA's overall strategy, the draft of which will be consulted upon in 2010.

We apply strategy within our estate by issuing Site Strategic Specifications to the Site Licensee Companies.

2.3 State of maturity of radioactive waste strategy

Our current strategy for radioactive waste is provided within the published 2006 NDA strategy.

Since that time, and as required by Government, we set up a programme of work to develop the UK nuclear industry LLW strategy. Following consultation, assimilation of feedback and Government approval, the outcome will be a mature and fit-for-purpose UK LLW strategy in 2010/11.

The direction of travel for HAW has been set out by Government in the Managing Radioactive Waste Safely (MRWS) White Paper, 2008. This, together with NDA's programmes for cleanup of civil nuclear liabilities, provides a strategic context. We are addressing the issues in our HAW topic strategy but there remains scope for an all-encompassing UK Nuclear Industry Strategy along the lines of the one prepared for LLW. The divergence of UK waste disposal policy[1] and emerging Scottish policy[2] needs to be reflected.

3.0 Overview

3.1 Background information on radioactive waste

This document focuses on strategic direction, and therefore does not attempt to provide a briefing on definitions of waste or quantities and locations, which are already covered in detail elsewhere. The 2007 UK Radioactive Waste Inventory (UKRWI) provides both detailed and summary information, including site-specific data and a volume describing waste production.

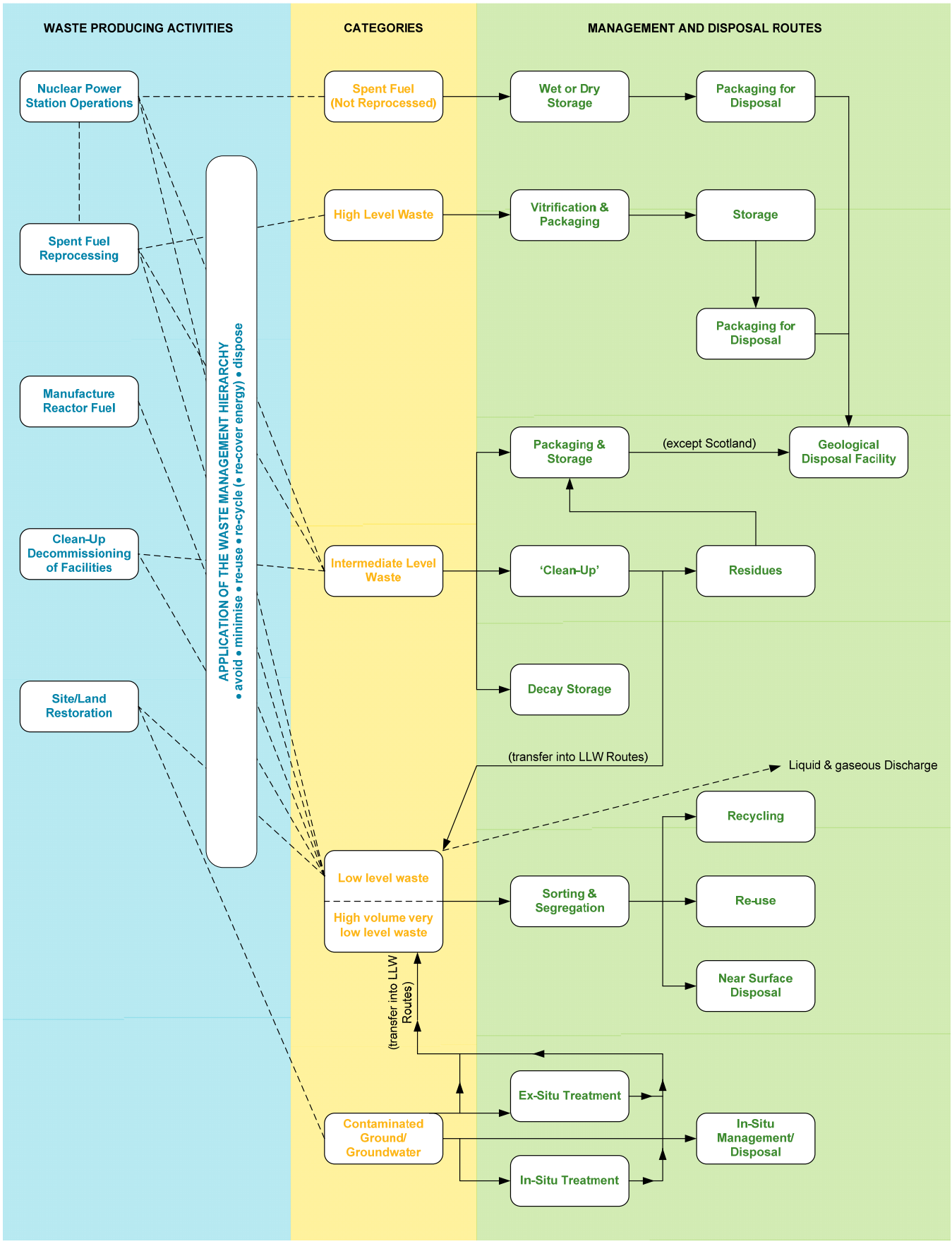
The 2007 UKRWI can be regarded as a companion document to this IWS. It is available as a printed document, on a CD, and at our website[3]. The next update to the UKRWI is scheduled for 2010.

An overview of the origin and management of radioactive waste in UK is shown in the following diagram (next page):

[1] Managing Radioactive Waste Safely White Paper, June 2008, describes the framework for implementing geological disposal of higher activity waste

[2] On June 25, 2007 the Scottish Government announced that its policy for the long-term management of Higher Activity Radioactive Waste would be: "to support long-term "near surface, near site" storage facilities so that the waste is monitorable and retrievable and the need for transporting it over long distances is minimal.

[3] http://www.nda.gov.uk/ukinventory/


WASTE PRODUCING ACTIVITIES
CATEGORIES
MANAGEMENT AND DISPOSAL ROUTES
Nuclear Power Station Operations
Spent Fuel Reprocessing
Manufacture Reactor Fuel
Clean-Up Decommissioning of Facilities
Site/Land Restoration
APPLICATION OF THE WASTE MANAGEMENT HIERARCHY
• avoid • minimise • re-use • re-cycle (• re-cover energy) • dispose
Spent Fuel (Not Reprocessed)
High Level Waste
Intermediate Level Waste
Low level waste
High volume very low level waste
Contaminated Ground/ Groundwater
Wet or Dry Storage
Vitrification & Packaging
Packaging for Disposal
Storage
Packaging for Disposal
Packaging & Storage
(except Scotland)
Geological Disposal Facility
'Clean-Up'
Residues
Decay Storage
(transfer into LLW Routes)
Liquid & gaseous Discharge
Recycling
Sorting & Segregation
Re-use
Near Surface Disposal
(transfer into LLW Routes)
Ex-Situ Treatment
In-Situ Treatment
In-Situ Management/ Disposal

3.2 Sources of radioactive waste

Activity/source	Inside NDA estate	Outside NDA estate	Wastes produced	Issues
Research, prototype and operational nuclear reactors*	✓	✓	• Operational waste (and stored operational waste, considered 'legacy' or 'historical') • Authorised discharges • Decommissioning waste • Spent fuel	• Treatment of process wastes (eg ion exchange resins) • Cleanup or treatment of various wastes held at reactor sites • Wastes from the decommissioning process – the reactor facilities and installations such as fuel ponds • Contaminated ground and groundwater
Uranium enrichment / manufacture of fuel for nuclear reactors	✓	✓	• Operational waste • Authorised discharges • Decommissioning waste	• Treatment of process wastes including residues • Wastes from the decommissioning process • Contaminated ground and groundwater
Reprocessing of used reactor fuel**	✓		• Operational waste (and stored operational waste, considered 'legacy' or 'historical') • Authorised discharges • Decommissioning waste	• Fuel cladding waste • Process wastes • Liquid high level waste • Wastes from the decommissioning process • Contaminated ground and groundwater
Manufacture of nuclear weapons		✓	• Operational waste • Authorised discharges • Decommissioning waste	Most wastes from defence sector consigned to NDA disposal facilities
Medical and research activities		✓	• Sealed sources • Low activity materials	Some wastes consigned to NDA disposal facilities
* including operation of nuclear powered submarines				
** fuel reprocessing represents a major source of HAW. Some waste arisings are owned by British Energy, some by overseas utilities, and others by NDA				

All the activities listed produce quantities of LLW, which makes up the largest proportion of the total. ILW (which is more radioactive) is produced as a result of fuel reprocessing and the operation of nuclear power plants, and more results from decommissioning and cleanup activities. In the UK definition, the term HLW is restricted to the heat generating products of reprocessing, initially held in liquid form, and subsequently immobilised by vitrification. We often use the term 'higher activity waste' (HAW) to encompass both ILW and HLW and to differentiate them from LLW or 'lower activity waste', LAW, for which the management approach is somewhat different.

At present a degree of uncertainty surrounds a number of contaminated ground and groundwater issues within the NDA estate. Some of the contaminated material is already considered 'waste' which may require systematic retrieval and appropriate treatment and disposal. On the other hand where suitable safety and environmental

arguments can be made, it might be appropriate to leave a proportion of the contaminated ground and groundwater in-situ.

The waste liability cannot be regarded as 'fixed'. Spent fuel reprocessing operations continue to result in the production of waste and for operations such as future decommissioning the radioactive materials and items in-situ are considered 'future waste arisings'. An example of future arisings is in-situ radioactive material awaiting the decommissioning of power stations and process plants.

3.3 Principles to underpin strategy

We consider that the following principles should underpin waste strategy:

1 Give priority to reducing risk by retrieval and immobilisation of potentially mobile historical wastes stored on NDA sites.

2 Support the core NDA principles of protecting safety, security and the environment, and value for money.

3 Apply the Waste Hierarchy:

← preferred approach			less preferred approach →	
● avoid	● minimise	● re-use	● recycle	● dispose

4 Drive for 'early' waste solutions rather than leaving waste liabilities un-addressed. Waste management activities must be integrated with other activities and take account of the sustainability principles.

5 Decide how to manage wastes on the basis of business cases that take account of Principles 1 to 4.

6 Engage with our stakeholders about potential and actual developments in waste management from earliest stages.

Subject to complying with State Aids legislation and NDA's *vires* under the Energy Act, a UK-wide approach to waste management should be pursued by NDA where this could help minimise risk and cost, and facilitate effective clean-up. This requires harmonisation of plans and strategies, and approaches to cost estimation and risk.

With regard to Principle 3 we emphasise the need to investigate opportunities to avoid production of waste. Effective application of the Waste Hierarchy depends on suitable characterisation and segregation of waste materials.

With regard to Principle 5, it is recognised that waste management strategic and operational decisions need to be based on issues such as safety benefit, environmental protection and so-on. We have set out a value framework approach to decision making, and uses the UK Treasury 'five-case model' for business cases. Thus waste management strategic and operational choices need to comply with this process. This enables relative priority to be assessed.

The business case approach brings objectivity to the application of the waste hierarchy and an appreciation of the full lifecycle value of alternative options. While waste recycling is considered desirable in general it should not be pursued where the business and environmental arguments for disposal are stronger.

Within this framework, high-level issues need to be addressed, such as potential security management benefits of consolidating waste storage and the impacts of transport within options entailing waste transfers. Consolidating waste treatment and

storage might not always be the optimum strategy if there is a benefit (such as system robustness) in a diversified approach.

3.4 Learning from site integrated waste strategies

A commentary on points drawn from analysis of site IWSs is provided in Appendix 4. These can be summarised as follows:

- The opportunity to minimise the ILW to be consigned to geological disposal.
- Consolidation of waste storage.
- The opportunity to take a more-multi-site or centralised view on waste treatment.
- The need to press ahead to secure robust waste transport arrangements.
- The opportunity to deploy expert teams to address waste challenges and opportunities across multiple sites.
- The need for enhanced sharing of good practice across sites and between SLCs.
- The opportunity to make more use of waste incineration.
- The opportunity to make more use of metals treatment and recycling.
- The opportunities for diversified disposal of very low level waste (VLLW), including on-site and near-site disposal options.
- The need to secure routes for non-active waste having a nuclear site provenance.
- The specific need for research into alternative solutions for the large quantity of reactor graphite waste that will result from reactor decommissioning.
- The opportunity for a more joined up approach to handling waste information, to encompass operational site record systems and the UK inventory.

Many of these issues have been discussed with our National Stakeholder Group and are being addressed within NDA topic strategies. The broader issues surrounding good practice and centralised/multi-site approach, for example, are picked up in the following chapter of this document.

We consider that site IWSs represent important planning and communications tools, and support their continued use and development. They will continue to inform NDA strategy. We will seek to have them all openly available.

4.0 Our strategy for waste

As noted earlier, this document avoids duplication of the more detailed strategic work provided at topic strategy level. However some topic-level issues are noted here for the purpose of illustration.

Waste management strategy needs to take account of the Principles introduced above and reflect the following objectives:

- Achievement of risk reduction;
- Maintenance of security;
- Optimised operations, value for money;
- Robustness/flexibility of waste management in the event of policy change or factors outside our control; and
- Availability of capability and skills base.

These requirements influence our high level strategic approach to waste, as described below.

4.1 Achievement of risk reduction

We will continue to prioritise risk reduction by retrieval, processing and immobilisation of wastes held in legacy or historical ponds and silos. It is recognised that this task poses major technical challenges and entails substantial resource and financial demands. This work is central to our environmental restoration mission.

4.2 Maintenance of security

Waste in storage and in transit needs to be managed safely and securely at all times, and this is the subject of detailed regulatory control. We see no opportunity for changed strategy in this area. However, improvement in security conditions is a factor in evaluating waste management options (see Principles in 3.3).

4.3 Optimisation of waste operations

We own sites around the UK and these produce diverse waste streams and hold diverse wastes in storage. There is therefore scope for joined-up multi-site solutions in waste management. An example is in treatment of wastes, where a beneficial technology that might be prohibitively costly or otherwise impracticable for a single site might be feasible if it were to be applied to the programmes for a number of sites.

There are significant strategic opportunities for optimising waste management operations by taking a multi-site or centralised view, enabling promulgation of good practice and economies of scale. Examples of developing such opportunities are:

- UK scale services for managing LLW such as metals suitable for recycling. This has been launched.
- UK scale service for incineration of LLW where this is the best practicable environmental option. This is under consideration.
- Optimisation of the use of the Low Level Waste Repository by use of landfills and landfill type facilities for disposing of very low level waste where it is not amenable to treatment at higher levels of the waste hierarchy.
- A multi-site approach to thermal treatment of ILW for volume reduction/optimised waste forms. This could entail centralised facilities or mobile/relocateable waste treatment equipment.
- Shared interim storage of intermediate level waste from a number of sites. This opportunity has previously been largely discounted[4], but is being re-examined.
- The use of self-shielding waste containers instead of ‘unshielded’ containers in heavily shielded buildings is under consideration. This might be applicable in the context of ‘shared’ storage as described above.
- Alternative waste management options for graphite waste that will arise from decommissioning the ten Magnox stations in NDA’s estate, potentially minimising the volume destined for geological disposal. This opportunity is under investigation.
- Challenging the compartmentalising of LLW and ILW management techniques to achieve fit-for-purpose solutions. For example ILW materials such as metals are amenable to decay storage to LLW. Some ILW materials could be disposed of using LLW techniques if the safety case can be made.

We are engaging with non-NDA waste producing organisations to participate in such projects – Ministry of Defence (MoD) and BE have overlapping interests with NDA in a number of areas of waste management.

[4] UK Waste Storage Review 2009

A number of issues would need to be tacked before many of these waste management opportunities could be implemented. For example suitably licensed waste transport containers need to be available so that wastes can be moved on public transport systems. Local stakeholder concerns would need to be addressed; we have obtained advice on how to approach this via our National Stakeholder Group.

Waste management and indeed other operational opportunities at our sites are examined in the context of business cases, for which we publish guidance on our website.

4.4 Robustness/flexibility of waste management

We recognise that over the multi-decade duration of our site restoration mission there will be changes in UK policy, regulatory requirements, organisational structures and availability of funding.

Numerous factors can influence the approach to the management of radioactive waste:

- Change of UK Government policy or legal requirements.
- Changes of EU / international requirements (such as Euratom[5] and the Joint Convention on Radioactive Waste and Spent Fuel).
- Pressure on, or accelerated release of funding.
- Operational problems at sites, leading to delay.
- Problems negotiating Planning and other processes, leading to delay.
- Realisation of operational risks, necessitating revised strategy and tactics.
- Realisation of opportunities from technical, operational or commercial innovation.

In detail, a proportion of the above issues are handled as risk, opportunity and contingency issues in site lifetime plans. However, NDA has the responsibility for managing the larger scale influences on our operating environment. In order to handle this NDA maintains close contact with Government and industry regulators. We recognise that we hold the key 'client' role with regard to projects carried out at our sites and that this requires us to provide strategic direction that takes account of changing policy, regulatory and financial drivers.

There is a need to maintain the safety and security of radioactive waste throughout and to progress our overall decommissioning and cleanup mission. There is a need to have secure waste disposal routes available at the right time to support operations, decommissioning and site restoration work. We are pursuing increased flexibility in waste management, particularly with respect to treatment and disposal of Low Level Waste.

We are investigating the approach that could be applied in conditions of tightly constrained funding, where the investment in radioactive waste management needs to be set in the context of other national priorities. Prudent waste management arrangements are already in place, for example the 'Letter of Compliance' (LoC) process that under-writes the suitability of waste packages and their storage conditions.

In a highly constrained funding environment it would be important that progress is maintained on reducing the hazard of waste that is held in historic ponds and silo stores. Elsewhere there might need to be more flexibility on managing waste liabilities if it is necessary, for example, to slow down waste-producing activities such as decommissioning. These issues emphasise the existing need for continuous review and prioritisation of operations.

[5] The European Atomic Energy Community

4.5 Development and maintenance of capability and skills base

Skilled people and competent companies are necessary for NDA to discharge its mission. These issues are addressed in the appropriate NDA topic strategy. With regard to radioactive waste programmes we recognise five issues:

1 Suitable competence in managing radioactive waste needs to be held within the Site Licensee Companies who operate our sites;
2 Additional depth of UK and international waste management experience is provided by the Parent Body Organisations (PBOs) who own the SLCs;
3 There are opportunities to share waste management expertise between SLCs and sites more effectively;
4 We need competent 'open market' companies to provide competitive waste management services to our sites; and
5 Education and training arrangements in UK need to compliment our mission.

4.6 Enabling activities

4.6.1 Fostering good practice

Following on from the above narrative, we intend to reinforce sharing of good practice in waste management between SLCs, NDA sites, non-NDA sites and other parties in UK and internationally. At present there is a need for a more 'joined-up' approach: we are still seeing inconsistencies in waste management tactics between sites and local initiatives that take insufficient account of UK wide developments and opportunities. Our Site Strategic Specifications have a role to play. The need for coherence extends to the work of the existing Nuclear Waste Research Forum (NWRF) described in the R&D topic strategy.

Within this area we will promote the development and deployment of expert teams to tackle waste management challenges across the NDA estate. This initiative will help avoid duplication of resources and it supports to application of good practice. Achieving success in this will require careful attention to contractual issues and the identification of win-win mechanisms for the sites. A LLW management initiative of this type covering much of the NDA estate has already been launched.

4.6.2 Integrated waste management information

We already maintain the UK radioactive waste inventory and have various waste modelling tools. However we recognise the opportunity for improved integration with site waste information systems. We also see a particular need for a robust and long term system as an important source of information for the UK on wastes in storage over periods of many decades. We intend to work towards a centralised system that incorporates information on waste packages (identification, contents, history) and waste stores (design and operational details, examination, maintenance). We believe this should be UK-wide, not just for the NDA estate. We also expect that it will cover nuclear materials (uranium, plutonium) and spent fuel as potential waste in storage, subject to the incorporation of suitable security features. The physical/digital location of this information resource remains to be established.

5.0 Moving forward

5.1 Waste strategy and NDA's strategic objectives

We are in the process of aligning our overall programme of work against a number of 'strategic objectives' to focus its management effort and provide better visibility of

progress to Government and our stakeholder community. A feature of this initiative is to concentrate on targets achievable within the next decade.

The strategic objectives reflect NDA's mission, which is risk reduction and clean-up of sites. With regard to waste strategy the key activities are:

- Emptying high risk historical waste stores
- De-fuelling reactors and putting them into relatively passive care and maintenance conditions
- Management of used reactor fuels
- Disposal or safe storage of wastes
- Clean-up of sites to interim or final end state conditions

At the more detailed level we will manage and report progress on individual elements of our programme. The following ones contain important waste management aspects.

- Remediation of Legacy Pond and Silo waste stores.
- Taking all the Magnox Reactors into care and maintenance conditions.
- Taking the Dounreay site into its interim end state.
- Taking the Harwell and Winfrith sites to de-designated states.
- Reprocessing oxide reactor fuels, with non-reprocessed fuel stored as a potential waste product.
- Putting all Exotic Fuels* in final disposition form.
- Implementing the programme for the UK Geological Disposal Facility.
- Optimising management of LLW to make best use of the Low Level Waste Repository and pursue the waste hierarchy.
- Optimise ILW practices and manage ILW in storage.
- Production and safe storage of HLW.
- Management of stocks of civil plutonium, including possible waste forms, depending on national policy decisions.
- Management of stocks of civil uranium, including possible waste forms, depending on Government policy decisions.

* 'Exotic fuels' are defined as fuels from research and other reactors outside the main Magnox and oxide fuelled electricity generating reactor programmes.

In respect of the above strategic objectives, where appropriate, opportunities will be taken to integrate/optimise plans between the NDA estate and non-NDA waste producers to ensure consistency, coherence and cost and risk mitigation.

5.2 Future activities in integrated waste strategy

The process for generating and presenting NDA site IWSs is becoming more mature, and we are now seeing increased use of annual updates rather than full new strategies being produced every year. We will engage with sites and regulators to examine the opportunity for an updated specification for this activity and to promulgate 'lessons learned'. There is scope to improve consistency between site IWSs, recognition of multi-site opportunities and application of the IWS in site-level planning. We are also engaging with BE who have agreed to produce a fleet-wide IWS for their existing nuclear sites by 2011 and which we expect to be progressively matured thereafter. This will provide further opportunity for integration of approaches between NDA and BE which will ultimately benefit the UK taxpayer.

We will continue to focus on developing waste related strategies at topic level within the SMS in order to support the production of NDA strategy. Centralised and multi-site opportunities for integration are key features at topic level.

Waste strategy will remain the subject of detailed interactions with Government and Regulators as well as our day-to-day engagement with sites.

We will continue the dialogue with our National Stakeholder Group on waste issues.

For the future we expect the emphasis to move from strategy development to focus more on pursuit of specific waste management opportunities and delivery of the strategic objectives.

Appendix 1: NDA's role in waste management

NDA and waste management

NDA is a non-departmental public body, established under the Energy Act 2004. We are responsible for the decommissioning and clean-up of the UK's civil public sector nuclear sites. Our sponsoring Government department is the Department for Energy and Climate Change (DECC); for some aspects of our functions in Scotland we are responsible to Scottish Ministers
Effective management of radioactive waste is central to our mission. Government has made us responsible for:

- developing UK-wide nuclear LLW strategy and plans[6];
- the long-term management arrangements for the UK's higher radioactive wastes[7]; and
- 19 former UKAEA and BNFL sites, all of which have radioactive waste management features[8]
- oversight of the discharge by BE of its liabilities which qualify for funding from the Nuclear Liabilities fund, including waste management and disposal of LLW, ILW, HLW the management of spent fuel.

With regard to the operation of our sites the Energy Act 2004 gives us specific responsibilities with regard to treatment, storage, transportation and disposal of waste and hazardous material. It also covers the management of contaminated ground and groundwater, which is a closely related issue.

While from the UK perspective the NDA estate contains the majority of radioactive waste liabilities, we do not have responsibility for all of the radioactive waste in the country. Areas where we do not have direct responsibility are:

- Non-Nuclear Industry LLW Strategy and waste producing activities at educational, research and medical establishments except for disposals to the Low Level Waste Repository (LLWR) near Drigg, an NDA site.
- Defence sector radioactive waste, except for disposals to the LLWR, an NDA site.
- British Energy (BE) sites.

We engage with many parties both within and outside our direct areas of responsibility. We have a Memorandum of Understanding with MOD to collaborate to progress waste management challenges in the MOD estate. For example we are working with Ministry of Defence on disposition of waste that will arise from the Submarine Dismantling Programme. We interact with non-NDA waste producers in the context of the disposal of waste to the LLWR, and the development of the GDF. With regard to these wider aspects, the NDA must ensure it complies with its *vires* set under the Energy Act, and with State Aids legislation.

We have a leadership role in UK radioactive waste management, and the majority of the infrastructure is within the NDA estate (NDA sites, installations, direct contracts). The present situation is summarised below. We seek to make good use of the infrastructure within our estate while encouraging increased participation from outside the estate.

Our operating framework

We do not directly manage the facilities that we own. Instead we contract out the delivery of site programmes through management and operation contracts with licensed operators, Site Licence Companies (SLCs). They manage the sites, including preparing and operating site

[6] Government's UK Low Level Waste Policy, 2007
[7] Government's Managing Radioactive Waste Safely White Paper, 2008
[8] Those designated under the Energy Act 2004

plans with the agreement of NDA. Each site has waste management responsibilities which are scrutinised by industry regulators, and maintains an IWS and a waste tracking or information system.

In NDA we monitor the achievement of waste management objectives at the sites, and incentive mechanisms are used within the contracts. We take a multi-site and UK-wide view of waste challenges and opportunities as well as engaging with the sites on individual waste-related projects. It is recognised that there is considerable scope to improve multi-site performance. Where appropriate we take the role of client/sponsor for projects that explore waste management opportunities or risk issues.

	Inside the NDA estate	Outside the NDA estate, but in UK
Radioactive waste liabilities	Some 90% of the radioactive waste originates on NDA sites	Some 10% of the radioactive waste originates on non-NDA sites (mainly BE and MoD)
Waste treatment capability	Treatment arrangements are mainly focussed on NDA sites (ie close to the sources of waste production).	• Limited treatment infrastructure is held by BE and MOD. • There are private sector initiatives in providing treatment solutions for LLW metals and high force compaction.
Waste storage	Substantial storage arrangements are in place, particularly at the Sellafield site, which is the source of the majority of UK radioactive waste.	Stores exist on some BE and MOD sites. Small amounts of waste held in laboratories and by the medical industry.
Waste transport	• NDA owns Direct Rail Services, who handle UK civil reactor fuel transport and who can in principle therefore handle waste (ILW) transport.	LLW is generally transported by contractors.
Waste disposal (LLW)	• LLWR near Drigg, Cumbria. • Nuclear sector responsibility under the 2007 LLW Policy. • A new local facility is being developed for Dounreay, Caithness.	• Clifton Marsh and other landfill disposal facilities in the supply chain that accept relatively small amounts of LLW • Incineration capacity in the supply chain
Waste disposal (Higher Activity Wastes)	NDA is responsible for the UK programme to develop the geological disposal facility.	None
Waste information	• NDA compiles and maintains the UK inventory. • Extensive waste information systems are in use at NDA sites.	Site-by-site waste information systems.
Waste science and technology	The majority of waste-related R&D is sponsored by NDA directly or via NDA site contractors.	• Limited waste-related R&D is understood to undertaken by BE and MOD.
People resources	Over 20,000 people work at NDA sites, most of which carry out substantial waste management activities. Many more people support the sites through the supply chain. Important radioactive waste management skills are thus held by some thousands of people in the NDA estate.	• Resources at BE and MOD sites. • R&D workers outside NDA estate. • Private companies.

On the basis of this analysis it can be seen that NDA waste strategies tend to dominate UK strategies. NDA interacts with Government, Regulators, supplier companies and universities with a view to aligning strategies to optimise the management of radioactive waste in the UK.

Not all of the waste issues noted in the above table are sufficiently well 'joined up' at present, and there are thus opportunities for improvement. For example the 'knowledge base' is quite fragmented, this impeding operators and other decision makers from tapping into best practice.

What NDA does

NDA's role in waste management can be summarised as follows:

- We authorise and fund waste management operations at our sites via administration of contracts dependent on the site LTPs. Any substantial waste-related investments proposed at sites are subjected to an NDA Expenditure Review Process (ERP). However, waste operations and detailed proposals for waste related developments are matters for regulatory scrutiny of the SLCs.
- We sponsor generic research and development for radioactive waste.
- We facilitate good practice in waste management via industry groups.
- We participate in UK and international conferences and technical meetings on radioactive waste issues.
- We encourage supply chain companies who offer new ways of addressing radioactive waste management challenges.
- We manage the compilation of the UK waste inventory on behalf of Department for Environment, Food and Rural Affairs (DEFRA).
- We have a responsibility to develop strategy for radioactive waste in our estate to fulfil NDA's obligations under the Energy Act 2004. We also have specific wider duties with regard to management of LLW and UK Strategy for Nuclear Industry LLW under Government's 2007 Policy.
- We were made responsible for implementation of the UK geological disposal programme by Government in 2006.
- We have direction from Government for oversight of the discharge by British Energy of those of its liabilities which qualify for funding from the Nuclear Liabilities fund, and this includes waste management and disposal activities.

In practical terms, addressing the above functions requires close interactions with waste producers (the SLCs and others), regulators, government and local government departments, government agencies, supply chain companies, universities, unions and industry organisations and NDA's wide stakeholder community. We maintain international links on technology and strategic development in waste management.

Some key NDA interactions on waste strategy are:

- With Government's Committee on Radioactive Waste Management (CoRWM)
- Waste Management Steering Group (WMSG - with NDA's sponsoring departments)
- Strategy Development and Delivery Group (SDDG – with Government and Regulators)
- Radioactive Waste Policy Group (RWPG)
- Low Level Waste Strategy Group (LSG – with UK waste producers, central and local government, Regulators and their stakeholders).
- NDA's National Stakeholder Group (NSG),

There are numerous other day-to-day interactions with SLCs, Regulators, British Energy, MoD, specialist companies and diverse stakeholders.

On behalf of Government we represent the UK in the Global Nuclear Energy Partnership (GNEP), and have involvement on waste management strategy in that context.

Within NDA the accountability for developing and maintaining waste strategy lies with the Head of Waste and Nuclear Materials, who leads a department of waste and fuel cycle specialists. A separate unit within NDA, Radioactive Waste Management Directorate (RWMD), runs the geological disposal development programme as well as providing waste packaging advice and developing waste transport solutions. Our interface with our sites (including on waste management) is handled within the Programme Assurance function 'site facing teams' lead by Programme Directors.

Appendix 2: The existing/generic approach to waste management

Existing waste management practices in the NDA estate can be considered to comprise the current 'baseline' strategy. Elements of current practise are summarised below.

Low level waste

- Most UK solid LLW is sent to NDA's LLWR near Drigg in Cumbria.
- Some LAW is sent to the Clifton Marsh facility in Lancashire.
- A planning consent has been granted to construct a new LLW disposal facility at the Dounreay site.
- Limited use is made of incineration to dispose of LLW.
- Limited use is made of suitably licensed landfills for VLLW and non-active waste from NDA sites.
- Increasing use is being made of metal decontamination and melting (outside UK) for recycling and re-use of waste metals.

Higher activity waste (intermediate and high level)

- ILW is packaged for eventual disposal according to LoCs issued by NDA's RWMD. Most is packaged in stainless steel drums and boxes.
- NDA places great emphasis on the retrieval and safe storage of 'legacy' or historical intermediate level waste materials where these are held in old facilities that don't meet modern standards.
- Most ILW is scheduled to be stored at its site of origin, to be transferred to geological disposal once the disposal facility is available (estimated to be from year 2040).
- Vitrified HLW is held at Sellafield pending the availability of geological disposal route, which is estimated to be from year 2075 for this material.
- NDA is responsible for implementing the UK programme for geological disposal of HAW.

Decommissioning activities and scheduling of storage

- NDA promotes decommissioning of nuclear facilities in a prioritised manner, the principle consideration being to reduce hazard.
- Some future major decommissioning activities (such as the Magnox power stations) are tied to the availability of geological disposal. The de-fuelled Magnox reactors provide relatively low hazard conditions for the waste materials held in-situ. Therefore there are no current plans to decommission the reactors into interim storage arrangements. The present baseline assumption is that reactors will be decommissioned when a suitable waste disposal route is open, but it is noted that Regulators have not yet explicitly approved this approach.

Waste information

- NDA manages the production of the UK radioactive waste inventory on behalf of DEFRA. We are investigating the feasibility of moving to a 'near real-time' inventory arrangement.
- Sites have their own waste information and waste accountancy arrangements.

Non-radioactive and hazardous wastes

- NDA sites pursue normal industrial practices for the management of their non-radioactive waste.

Authorised discharges

All sites have authorisations for discharge of liquid and gaseous wastes. They are required to apply Best Available Techniques (BAT) or Best Practical Means (BPM) to minimise radioactive discharges and also the impact of those discharges which cannot be avoided. The revised UK Discharge Strategy published by DECC in 2009 sets out how the UK will deliver its commitments under to OSPAR convention and includes assessments of likely future discharges from the UK nuclear industry including the NDA's sites.

The above operations are subject to Regulatory control by the appropriate health and safety, environmental, security and transport authorities and in line with the applicable planning consents.

Appendix 3: Protecting and developing the waste infrastructure

NDA's waste management strategy is not necessarily about change. It is important to identify and protect infrastructure and operations necessary for the effective management of radioactive waste. Specific instances are noted below.

Low Level Waste Repository near Drigg

While NDA is pressing for more diversified LLW solutions, the important long term role of LLWR is recognised. Thus NDA supports LLWR Limited in closing out authorisation issues with Environment Agency, in its development of the site, and in its responsible interactions with its customers and the local community.

New Low Level Waste Disposal Facility at Dounreay

The decision in principle to dispose of Dounreay LLW at Dounreay has already been taken, and a planning consent for a new facility has been granted. While future technical advances might somewhat reduce the overall quantity of waste to be consigned to this facility, NDA is keen to see this development completed.

'Letter of Compliance' process for higher activity waste

NDA is interested in improved waste packaging solutions, but recognises the value of the existing LoC process to waste producers. The process is described on our website. The present arrangements enable waste producers to plan for waste packaging to meet established interim storage and disposal requirements. Therefore any transition to innovative packaging solutions will be handled carefully and in the context of the LoC approach. All waste producers are urged to support this, although use of the LoC process is not mandatory.

NDA's role with regard to the Geological Disposal Facility

While various waste innovations will, if implemented, reduce the amount of waste to be consigned to geological disposal, NDA considers that the UK GDF is required in all scenarios. Therefore NDA's GDF implementation programme will be protected and sustained.

It is noted that Scottish Government is consulting on a radioactive waste policy entailing 'near surface, near site' storage of higher activity waste rather than geological disposal. We will align our strategy to the new Scottish policy when instructed to do so by the Government departments that sponsor NDA.

Non-radioactive, hazardous and mixed waste management and disposal

NDA sites handle their non-radioactive and hazardous wastes according to usual industrial good practice. NDA sees no need for significant strategic change on this issue, but urges the sites to make use of re-use and recycling opportunities in line with the Waste Hierarchy.

For hazardous non-active waste management, the method generally planned or employed by waste producers is to transfer the waste to a suitably authorised off-site facility. Disposal to special hazardous waste landfill requires consent from the relevant Environmental Regulator. Experience shows that even for non-hazardous non-active wastes there is a risk that the material will not be accepted by disposal facilities or local authorities because of its nuclear site provenance.

NDA's approach to non-active wastes is to support good practice and the use of learning networks and guidance. Waste producers describe their approach in their site IWSs.

Appendix 4: Themes from site integrated waste strategies

Themes drawn from the 2008 IWS documents prepared by the NDA sites are summarised in the following table.

Issue	NDA commentary
Optimise treatment of ILW Opportunity to minimise the quantity of ILW sent to geological disposal by application of segregation, treatment technologies and enhanced immobilisation; opportunity for increased use of dissolution of fuel element debris.	These issues can be addressed by individual SLCs to optimise their own waste management. We are supportive of innovations, and will assist SLCs for example in their interactions with Regulators. (See also Multi-site synergy below)
Efficient waste storage Opportunity to consolidate ILW storage rather than have waste stores at each site	We regard the distributed arrangement of waste storage to be appropriate, and currently have no plans to consolidate waste storage centrally. Previous work has shown that there are opportunities for some shared storage capacity at southern sites, and supports the SLCs in investigating the opportunity. Local stakeholders will have interest in transport movements and the concept of shared facilities.
Multi-site synergy Opportunity to have centralised or multi-site treatment programmes for certain types of ILW (eg ion exchange resins); opportunity for NDA to lead on engagement/consultation for multi-site waste management opportunities.	We are investigating multi-site/centralised waste treatment opportunities and are keen to develop this opportunity, supporting the Magnox South 'wet waste' project. We will also take a wider view of such opportunities and engage with Regulators, Government Departments and stakeholders as they develop. We will investigate the business case for UK coverage thermal waste treatment capability.*
Transport enabler The need to have transport safety cases and authorisations to handle any proposed waste transfers, eg for consolidated storage	The point is accepted by NDA. The Transport and Logistics Topic Strategy will consider this issue.
Skills Opportunity to have teams skilled in individual waste treatment or handling operations operating across multiple sites, rather than developing teams to handle each task at each site	We will investigate covering this opportunity via a 'Best Practice Forum' or similar institution.
Knowledge Opportunity to improve sharing of experience and best practice in waste management between operators and sites. Better visibility of strategic and multi-site initiatives. Better sharing of historical development work.	We will investigate covering this opportunity via a 'Best Practice Forum' or similar institution. This issue will also feature in the NDA Knowledge Management topic strategy.
Incineration Opportunity to make increased use of incineration of LLW; the need to have incineration facilities with authorisation to match the potential waste throughput.	We will get involved in interactions with Regulators on authorisation limits as required (for example when considering the total demand from a number of sites), but this is principally a matter for the SLCs and incinerator operators. LLWR Limited is investigating opportunities for new incineration services.*
Metal Opportunity for centralised metals treatment/recycling solutions	LLWR Limited has launched a metals service for all their LLW disposal customers. NDA will work with LLWR to investigate the business case for a UK LLW metals smelting capability. However, open market suppliers are free to offer their own solutions.

Issue	NDA commentary
Diversified LLW/VLLW disposal Opportunity to develop on-site disposal facilities for LLW and very low level waste (eg at some Magnox stations); also opportunity to develop new very low level waste disposal facilities near sites. Opportunity to make use of suitably authorised landfills for very low level waste.	These points align to Government's 2007 LLW policy. We support diversified LLW/VLLW disposal. LLWR Limited is investigating opportunities for new VLLW disposal routes that eliminate the need to send such materials to the LLWR.
Non-active waste A need to secure disposal (and potentially recycling) routes for non-active waste having a nuclear site provenance.	Sites should seek to resolve this locally. We will provide support to initiatives on request.
Graphite The need for research and development into suitable waste forms for reactor graphite; the need for a UK graphite management programme	NDA supports UK participation in the EU Carbowaste programme on treatment and disposal of irradiated graphite and supports Magnox South programme on graphite waste forms.**
Waste information Opportunity for enhanced waste information management; possible extension of the use of the Waste Accountancy Template	NDA is running an initiative to: simplify production of the UK inventory; foster common practice on waste information amongst waste owners; and provide a central UK system for information on waste held in interim storage.

* Specific initiatives need to align with the Principles and business case process introduced earlier in this document.

** We consider the graphite issue to be tied to the wider reactor decommissioning waste management opportunity.

In addition to pursuit of the waste hierarchy and continuous improvement of waste management at site level, two broad areas where sites would benefit from NDA intervention at the strategic level are evident:

- Opportunities for more joined up working between sites and 'economy of scale' solutions.
- Opportunities for more diversified waste disposal routes.

Abbreviations

BE	British Energy
BPM	Best Practical Means
CoRWM	Committee on Radioactive Waste Management
DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
ERP	Expenditure Review Process
GDF	geological disposal facility
GNEP	Global Nuclear Energy Partnership
HAW	higher activity waste
HLW	high level waste
ILW	intermediate level waste
IWS	integrated waste strategy
LAW	lower activity waste
LLW	low level waste
LLWR	Low Level Waste Repository
LSG	Low Level Waste Strategy Group
MoD	Ministry of Defence
MRWS	Managing Radioactive Waste Safely
NDA	Nuclear Decommissioning Authority
NSG	National Stakeholder Group
NWRF	Nuclear Waste Research Forum
PBO	Parent Body Organisation
R&D	research and development
RWMD	Radioactive Waste Management Directorate
RWPG	Radioactive Waste Policy Group
SDDG	Strategy Development and Delivery Group
SLC	Site Licence Companies
SMS	strategy management system
UK	United Kingdom
UKRWI	UK Radioactive Waste Inventory
VLLW	very low level waste
WMSG	Waste Management Steering Group