


Optimising the number and location of interim Intermediate Level Waste (ILW) storage facilities on Magnox Limited and EDF Energy sites in England and Wales

Credible Options Main paper

May 2013





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Executive Summary

The Nuclear Decommissioning Authority (NDA) has made a commitment to consider the possibilities to reduce the overall costs, environmental impacts, and timescales of decommissioning by consolidating Intermediate Level Waste (ILW) management at fewer locations¹. The consolidation of interim storage of packaged ILW prior to disposal offers a significant opportunity of this nature.

Therefore, Magnox Limited (hereafter known as 'Magnox') and EDF Energy are reviewing the case for consolidating the interim storage of operational packaged ILW². Specifically, the project aim is:

“To establish which sites are the most appropriate locations for interim storage of Intermediate Level Waste across Magnox and EDF Energy Sites within England and Wales.”

This study is being undertaken following the NDA's Strategy Management System (SMS). The development of an individual strategy is managed in distinct stages. Stage A, "Define Credible Options," distils the initial options into a list of approaches that can credibly deliver the objective by applying screening criteria. Further work is then undertaken to identify the preferred option(s) (Stage B) and to test the ability to implement the preferred option(s) (Stage C).

In this study, a long-list of 22 possible options has been identified and is presented in this document.

Because all of the long-list options are technically feasible, lawful (provided the necessary consents are first obtained) and could be implemented within the constraints of the Magnox Optimised Decommissioning Programme (MODP), the approach to the screening exercise was to eliminate long-list options that on balance are clearly sub-optimal on those safety and environmental issues which were identified as important to stakeholders during a workshop held on the 12th - 13th February 2013.

Based on consideration of the application of the screening process, the long-list of options has been reduced to a shorter list of 8 credible options. This document provides this credible options list, with a summary of reasons for screening out the other options. It also provides an outline plan for further development of the options including plans for stakeholder engagement and dialogue.

¹ Nuclear Decommissioning Authority NDA Strategy, effective from May 2011.

² Magnox Limited are leading this study with EDF Energy sites in the scope.

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1 Introduction

1.1 Purpose

The Nuclear Decommissioning Authority (NDA) has made a commitment to consider the possibilities to reduce the overall costs, environmental impacts, and timescales of decommissioning by consolidating Intermediate Level Waste (ILW) management at fewer locations. The consolidation of interim storage of packaged ILW prior to disposal offers a significant opportunity of this nature.

Therefore, Magnox Limited (hereafter known as 'Magnox') and EDF Energy are reviewing the case for consolidating the interim storage³ of operational packaged Intermediate Level Waste (ILW) across the Magnox and EDF Energy sites which are located in England and Wales. Specifically the project aim is:

“To establish the most appropriate locations for the interim storage of Intermediate Level Waste across Magnox and EDF Energy Sites within England and Wales.”

This study is being undertaken following the NDA's Strategy Management System (SMS)⁴. Within this system, the development of an individual strategy is managed in distinct stages. Stage A, "Define Credible Options," distils the initial options into a list of approaches that can credibly deliver the objective by applying screening criteria. Further work is then undertaken to identify the preferred option(s) (Stage B) and to test the ability to implement the preferred option(s) (Stage C).

1.2 Scope

The scope of this opportunity is Magnox and EDF Energy operational ILW⁵ within England and Wales⁶ as shown in Figure 1. The scope does not include ILW which will be generated during the Final Site Clearance (FSC) period as the plan is that this will be dispatched directly to the GDF. Note that this study only considers which are

³ Interim storage of ILW is defined as storage of waste packages within a facility which aims to maximise the lifetime of waste packages and where there is the planned intention for a final management step, specifically the transfer of the packages to a licensed Geological Disposal Facility (GDF) when it becomes available.

⁴ This work will utilise NDA's Value Framework process [Ref. 1].

⁵ For the purposes of this paper operational ILW is defined as being ILW which is due to be packaged during the Care & Maintenance Preparations (C&MP) period.

⁶ The Scottish sites of Chapelcross, Hunterston A & B and Torness are the subject of a separate study [Intermediate Level Waste Storage Solutions: Central and Southern Scotland, Preferred Option, NDA, April 2013].

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sites are the best locations to store ILW and does not consider the choice of technology for doing so i.e. the type of package or store.

A number of Magnox and EDF Energy sites in England are co-located, specifically at Dungeness, Hinkley Point and Sizewell. In addition, Hinkley Point and Sizewell have been identified as future new build sites. Therefore, EDF Energy 'B' Station sites that are co-located with Magnox sites have been included within the study⁷.

To provide a useful comparison of the amount of packaged ILW at the various sites in scope which will require interim storage, UK Radioactive Waste Inventory (2010) data have been converted into package equivalents – see Figure 1. For this purpose it is assumed that one Type VI DCIC or one MOSAIK® or four 500l drums are equivalent to one equivalent package.

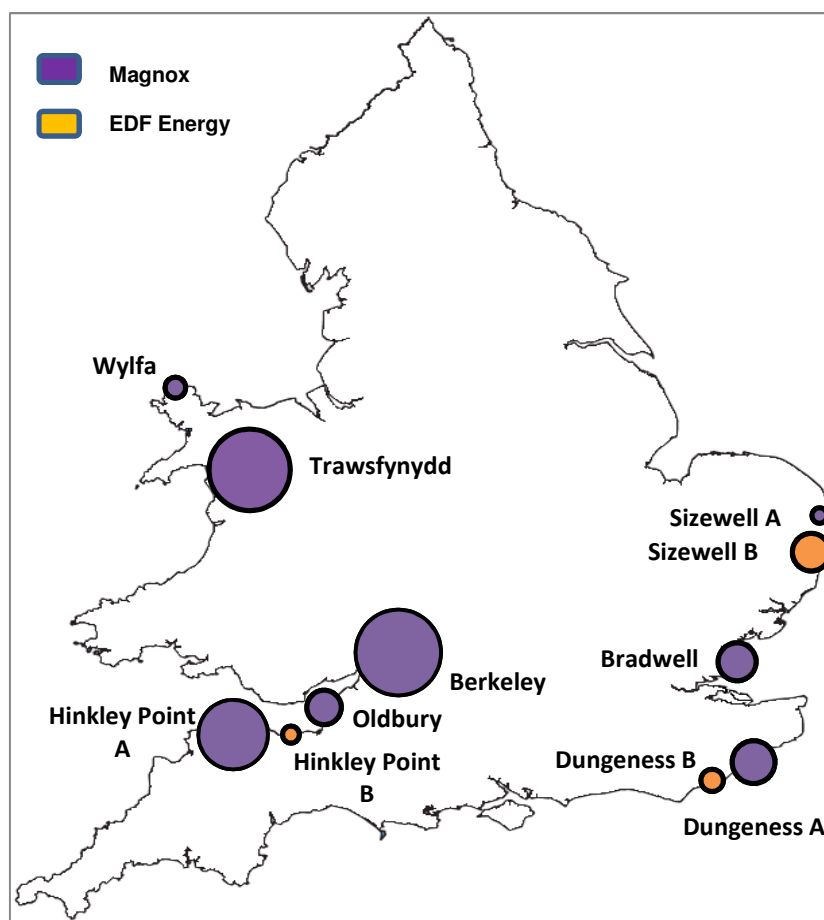



Figure 1. Summary of Intermediate Level Waste Considered in Scope

⁷ Heysham I and II and Hartlepool are therefore excluded from this study.



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For Magnox sites, it is assumed that Berkeley, Bradwell and Trawsfynydd will have interim ILW stores that will be used to store their own wastes (Bradwell and Trawsfynydd stores have already been constructed, and Berkeley's store is currently under construction). It is assumed for this study that these stores may be available to store wastes from other sites also (provided that there is spare capacity).

All other Magnox sites are potential donor sites and most are potential host sites, i.e. all other sites may transfer packaged waste for storage at another location, or may have a store for its own and potentially other sites' wastes.

Consolidation of ILW interim storage at Sellafield site is considered to be out of scope of this study. The NDA have previously stated that:

"The general approach is to look at the estate from a regional basis...the ultimate solution might well be at a more local level, for example, several stores within a region" [Ref 2].

In addition as stated above, Magnox has already constructed / is constructing some stores which would limit the ability to implement such an option, avoiding inter-programme issues where drivers are different, and technical challenges are different.

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2 Case for Change

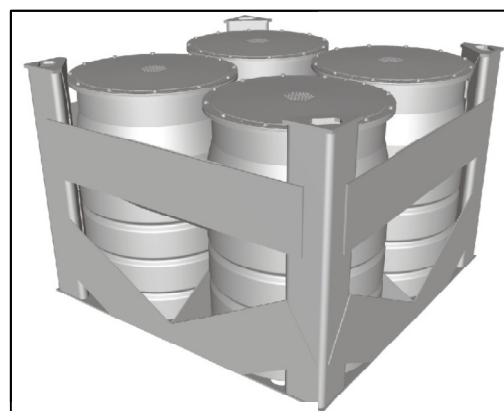
2.1 Current Position

The NDA reference strategy [Ref. 3] for the management of ILW is:

“...to achieve passive safety as soon as reasonably practicable, for longer-term storage and eventual disposal, or long-term management in near-surface facilities for wastes in Scotland. Depending on the timing of waste arising a period of some decades of interim storage may be required.”

The baseline plan for operational ILW interim storage at all of the sites in scope is therefore to retrieve, package and store the waste in purpose-built storage facilities taking due account of both regulatory and NDA guidance until final disposal in the proposed Geological Disposal Facility (GDF). However, there are some company and site-specific differences in the plans at a more detailed level:

- At most Magnox sites, the packaging strategy is to use Ductile Cast Iron Containers (DCICs) (Figure 2). These are to be held on site in purpose-built interim storage facilities that provide weather protection (and some shielding). However, at Trawsfynydd and Hunterston A sites the packaging strategy is to encapsulate (i.e. cement grout) ILW within 3m³ containers or other packages suitable for eventual disposal and to transfer these packages to an on-site purpose-built shielded ILW store.
- At most EDF Energy sites the current packaging strategy is to produce encapsulated packages in 500l stainless steel containers (Figure 3). An on-site ILW store would be required to provide physical and environmental protection; radiation shielding will be provided by concrete over-packs and the ILW store itself. However, at Sizewell B the use of DCICs is proposed for ILW resins.



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These differences affect ILW store designs, how the packages are handled and transported, and influence the credible interim storage options that are available in this study. In particular, where adjacent A and B sites have different waste packaging strategies, co-location of waste in the same storage building may not be practicable.

The baseline waste packaging strategies and package numbers for each of the sites in scope are summarised in Appendix A.

It should be noted that the use of DCICs at those Magnox sites where it is now the strategy⁸ is the result of site-specific options assessment studies undertaken in 2010, which compared the use of DCICs to encapsulation in 3m³ containers. In all cases, external stakeholders were involved in the 2010 option studies in workshop settings. Such studies were not undertaken for Trawsfynydd or Hunterston A as ILW stores and treatment facilities for those sites were constructed some time ago, before the use of DCICs became an option.

2.2 Reason for Review of Approach

Within the Higher Activity Waste section of the NDA Strategy (2011) [Ref. 4], the NDA has made a commitment to

"...explore opportunities to share current and planned storage assets to improve value for money, reduce the environmental impact of new store build and impact on decommissioning timescales [and] to take a multi-site and UK-wide view, to include its own sites and the operations of other waste producers, including EDF Energy..."

The consolidation of operational ILW interim storage across the Magnox and EDF Energy estates offers a significant opportunity of this nature. The potential reasons for change associated with this opportunity are described below:

2.2.1 Potential Safety and Environmental Benefits

The implementation of a shared interim storage approach has the potential to offer significant benefits in terms of both safety and the environment. The following provides a short summary of these potential benefits. This list is not intended to be exhaustive and it is possible that additional benefits will be identified by the project as the options become further developed:

⁸ This is subject to the Letter of Compliance (LoC) process. The aim of the LoC disposability assessment process is to assist nuclear sites in carrying out their clean-up and hazard reduction mission and to check that higher activity wastes will be packaged in a passive and disposable form so that any wastes packaged today should be compliant with future transport and disposability requirements (see NDA website).

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- Consolidation of waste storage would negate the need to build some of the planned new interim storage facilities. Reduced store construction could avoid use of a significant amount of materials (concrete, steel, metal cladding), and a reduced requirement for plant items such as craneage, ventilation systems and package maintenance and inspection facilities. This in turn would reduce transport disturbance and worker risk associated with construction.
- With fewer interim storage facilities being built, then during the operational phase there would be fewer facilities to maintain, reducing for example, the amount of cladding potentially requiring replacement, and reducing the monitoring requirements of the store. During the store decommissioning phase, there would be a reduction in the amount of material requiring waste management and fewer sites being disturbed.

A number of potential environmental detriments are also able to be identified when comparing the approach of shared interim storage to the current baseline strategies of interim storage at all of the sites in scope. Examples include the need to transport waste packages between sites and also the potential requirement to create greater buffer storage capacity than planned for within the baseline. These potential detriments will be investigated by the project to determine whether, on balance, consolidation of interim ILW storage offers overall benefit.

2.2.2 Economic Benefits

The implementation of a shared interim storage approach could offer significant economic benefits in terms of overall programme cost savings. Any saving is likely to be achieved principally through a reduction in design, construction, commissioning and decommissioning costs. The potential to optimise consumable and energy usage during operations may also lead to a cost saving.

Considering Magnox sites only (and excluding costs associated with Berkeley, Bradwell and Trawsfynydd that are common to all options), the range of lifecycle costs across the long-list of options have been estimated to be between approximately £40M (three stores only) to £78M (baseline of eight stores). In this estimation sums have been included for transport costs and any store modifications required.

2.2.3 Strategic Benefits

Strategic benefit may be realised through adoption of a shared ILW storage approach both in the near and longer-term. In the near-term, benefit would be realised through an increase in operational flexibility across the sites involved. For example early availability of storage space for some sites may enable earlier waste retrieval and packaging than currently planned.

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In the longer-term strategic benefit would be achieved through the reduction in the number of sites needing to export packages to the GDF. This would be likely to result in direct cost savings and also have the potential to benefit the Radioactive Waste Management Directorate of the NDA (RWMD) by reducing the complexity of the GDF emplacement schedule.

In Stage B of this project a more detailed investigation of the strategic benefits which could result from a shared interim storage approach will be undertaken.

2.3 Risks & Constraints

2.3.1 Assumptions

There are a number of assumptions which have been identified at this stage of the project:

- It is assumed that the UK Radioactive Waste Inventory (2010) and Magnox ILW Programme inventory information is valid. Therefore it is assumed that current estimates of package numbers do not change significantly in the future.
- All waste currently in scope will be placed into DCICs.
- In the case of use of DCICs, wastes are packaged such that the resulting packages are transportable on the day that the package is created. Also it is assumed that the transport of ILW packages in compliance with transport regulations is feasible.
- It is assumed that the necessary authorisations to permit waste packages to be imported to a site can be obtained.

2.3.2 Constraints

A constraint identified at this stage of the project is that there is a limited 'window of opportunity' which exists within the current ILW storage programme within Magnox, to allow for the investigation of this opportunity before significant funds are spent on implementation of the site-centric baseline.

No site constraints have been identified at this stage of the assessment that would affect the outcome (e.g. the lack of available space for the stores). This will be considered further during Stage B of this options assessment process.

2.3.3 Risks

The primary risks to the successful delivery of any proposal other than the baseline for shared ILW interim storage that have been identified at this stage include the following:

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- Acceptance of the justification supporting implementation of the preferred option by local authorities, the EA, and Office for Nuclear Regulation (and the Radioactive Materials Transport Team (RMTT)).
- The assumptions and data used in the options assessment are found to be invalid at a later stage. An example of this category of risk is that there is a significant change in package numbers, or that the packaging strategy is changed such that stores constructed earlier can no longer be utilised as planned.
- Future changes in regulatory standards and requirements at the time of implementation of any identified plan differing significantly from the standards and requirements that exist now. An example of such a risk would be a change in the standards required with respect to ILW interim storage. This might mean that waste arising many years after the assigned store had been constructed (for example EDF Energy waste packages) could not be stored in the assigned store and meet the standards applicable at the time.
- That options otherwise preferred may involve significant scheduling conflicts with other waste management or decommissioning projects, such as other ILW processing operations. This will be considered further during Stage B of this options assessment process.

2.4 Stakeholder Engagement

Magnox has a strong presence with regulators, and local and national stakeholders. Stakeholder engagement is continuous with a focus on creating, maintaining and building upon relationships through open dialogue and proactive engagement. As the project develops, Magnox will endeavour to maintain and build upon stakeholder relations through honest and transparent communications.

It is clear that a project of this nature will require engagement with a wide variety of stakeholders to determine the acceptability or otherwise of the preferred option and therefore the degree of confidence that the outcome is deliverable.

To date there have been a number of stakeholder engagement activities. These have included letters, attendance of project team members at some SSG meetings / sub-group meetings, regulator meetings and a workshop held in London on 12th – 13th February 2013⁹. These have provided an opportunity for Magnox to take into account the views of stakeholders on a number of safety and environmental issues as an input into the option screening process that is presented here.

⁹ The scope of this workshop also included consultation on the separate issue of FED treatment optimisation.

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3 Credible Options Assessment

3.1 Overview

In line with the NDA's SMS process [Ref. 1] a staged and proportionate approach to the assessment of potential options is being undertaken, described below.

OVERALL PROCESS FOR THE METHODOLOGY ADOPTED IN THIS ASSESSMENT		
STAGE A	Set Study Objectives	A clearly defined purpose / objective to be identified supported by a well-defined scope (described in Sections 1.1 & 1.2).
	Define Study Constraints	Define bounding constraints that would prevent or affect the delivery of an option achieving the overall objectives (Section 2.3).
	Identify Detailed Options	Produce a wide-ranging list of feasible options that can be considered to achieve the goals of the study (Appendix B).
	Screen Options Against Study Constraints	Screen the identified options against study constraints or other screening criteria whereby an option can be demonstrated to be clearly sub-optimal, to determine which should be taken forward to the next stage (Sections 3.2-3.6).
STAGE B	Evaluate Options	Options should be evaluated to determine the benefits and detriments of each option and allow comparison.
	Identify Preferred Option(s)	The process will draw together the relevant conclusions and recommendations, to identify the preferred option(s).

3.2 Long List of Options

In the first instance this study addresses optimising the interim storage of packaged ILW on Magnox sites only. This is because, in general, Magnox sites have more ILW than adjacent EDF Energy sites, and those wastes require management sooner. In addition, in general EDF Energy sites have different packaging strategies to the A sites, with most EDF Energy sites adopting a strategy of ILW encapsulation and interim storage in over-packs¹⁰. As noted earlier in this paper, the exception is at Sizewell, where both the A and B sites have a packaging strategy based on the use of DCICs, and Sizewell B will have more ILW to interim store than Sizewell A.

¹⁰ An initial feasibility study identified significant technical difficulties with storing EDF Energy encapsulated packages in Magnox DCIC interim storage facilities. In addition, encapsulated EDF Energy waste packages will not be transportable on public highways until a Standard Waste Transport Container is available.

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At a stakeholder engagement workshop on 12th -13th February 2013 there was strong preference for Magnox and EDF Energy to work together on interim ILW storage. Hence the following approach is taken:

- Scenario 1.

Magnox will consider its own preferred interim storage strategy (long-list options presented in Appendix B). No shared storage with adjacent B (or C) sites is assumed to take place. An option screening process has been undertaken on the Magnox-only long-list, and the results are presented later in this paper.

- Scenario 2.

Magnox has also produced and screened a long-list of options based on the total number of DCIC packages in each location assuming that EDF Energy adopts a packaging strategy based upon DCICs, so permitting shared storage to take place more widely than is possible at present. In this scenario, only one interim storage facility would be built between adjacent Magnox and EDF Energy sites (A-B Site consolidation) or else A-B site packaged wastes would be transported together to an alternative site (long-list options presented in Appendix C).

The shortlist that will be taken forward will be based on Magnox-only considerations (Scenario 1 above), but where options on that shortlist are compatible with options on the Scenario 2 shortlist this is highlighted. The issue of a shared approach will then be considered further in Stage B of this process.

For both scenarios above, the options are grouped into three categories:

- Baseline – each Magnox site (in Scenario 1) or location (in Scenario 2) has its own interim ILW store for its own waste only.
- Regional Options – some storage facilities are shared but only if they are located within the same broad region within the UK (south-west, south-east or North Wales) to reflect the consideration of the Proximity Principle in which it is preferred that development is conducted with the minimum possible amount of movement.
- Minimisation of Future Stores (if not included in regional) – the number of stores is minimised with sub-options considering three, four, five, etc. interim ILW store options (note that this category includes some cross-region waste transfers).

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These options were discussed at the stakeholder meeting on 12th - 13th February 2013¹¹. Stakeholders were given the opportunity to add further options and a number of suggestions were made¹². Magnox has subsequently considered these suggestions, resulting in the development of a second scenario (and associated set of options) based on the alternative assumption that all EDF Energy wastes are packaged in DCICs.

3.2.1 Options for ILW at Wylfa and Trawsfynydd

The options presented to stakeholders initially included options with variants of whether Wylfa does or does not have its own store, in the latter case its waste being transferred to Trawsfynydd.

This question of where to best store Wylfa's waste has been decoupled from the optimisation of storage for the sites in England¹³, for a number of reasons:

- There are only a small number of packages at Wylfa.
- The retrieval and packaging of the ILW at Wylfa is the last in the schedule.
- The DCICs could be sent to any appropriate site facilitating storage management (inspection, maintenance, export) where spare capacity exists.

Thus the storage location for the Wylfa waste packages will be decided nearer the time packages are created.

3.3 Value Framework Compliance

The attributes which were used to perform the option screening are in accordance with the NDA Value Framework process. Table 1 provides a summary of the high-level Value Framework attributes and shows at which stage of the project these attributes are / will be considered and the level of detail of the assessments conducted to support Stage A.

¹¹ Stakeholders at this meeting included Site Stakeholder Group / Local Community Liaison Committee members; representatives from local authorities; regulators, industry (Magnox and EDF), and the NDA.

¹² Details of the additional options suggested and Magnox's consideration of these are available on request.

¹³ The waste volumes for Wylfa are more uncertain and it is considered better to gain greater certainty prior to optimising.

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Table 1. Value Framework Attribute Compliance Assessment

Value Framework Attribute	Used in Stage A?	To be used in Stage B?	Stage A Specific Attributes
Safety	✓	✓	Public dose Worker dose Public conventional safety Worker conventional safety
Environment	✓	✓	Material use Waste arisings Carbon dioxide emissions Disturbance
Hazard Reduction	✗	✓	
Security	✗	✓	
Socio-economic	✗	✓	
Cost	✗	✓	

3.4 Identification and Application of Screening Criteria

3.4.1 General Approach

The screening of the options to reduce the long-list of options to a short-list of credible options took place by means of an Options Assessment Panel (OAP) on 13th March 2013. The screening meeting involved ILW package management consultants, radiological safety experts, an industrial safety expert and environmental specialists.

Because all of the long-list options are technically feasible, lawful (provided the necessary consents are first obtained) and could be implemented within the constraints of the Magnox Optimised Decommissioning Programme (MODP), the approach to the screening exercise was to eliminate long-list options that, on balance, are clearly sub-optimal on those safety and environmental issues which were identified as important to stakeholders during the workshop of 12th - 13th February 2013. The methodology is described further below.

3.4.2 Safety and Environment Factors

It is considered that all of the relevant safety and environment factors relate to two issues: construction and the transport of radioactive waste. These are discussed in turn below.

The options that involve more storage locations in general involve a larger amount of construction. This in turn leads to increased:

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- Conventional risks to workers.
- Materials use.
- Demolition arisings.
- Transport of construction and waste materials (leading to increased risk of accidents; carbon dioxide emissions).

However, options which involve fewer storage locations require more transport of radioactive wastes, leading to increased:

- Public and worker radiation exposure (note that implementation of any of the options would not give rise to doses which would challenge relevant legal limits).
- Risk of accidents (from transport).
- Carbon dioxide emissions.

Most of the factors listed above arise in the relatively short term. In the longer term, issues such as store maintenance and inspection, and the logistics of dispatching wastes to the GDF when available, are also affected by the number of storage locations.


In order to identify options with the best overall balance of these safety and environmental issues referred to above, it is necessary to decide which factors are most important in the decisions to be made.

3.4.3 Safety and Environment Factors Identified as Important by Stakeholders

Stakeholders' views were sought at the February workshop to identify the safety and environmental issues considered to be the most important for use in an exercise to screen the long list of options. The specific issues considered most important by stakeholders were:

- Public individual dose from the transport of ILW packages.
- Public collective dose from the transport of ILW packages.
- Worker collective dose from transport of ILW packages (for use in screening as a surrogate for industrial safety during loading and unloading operations).
- Public conventional safety from transport of ILW packages and construction and demolition materials.
- Worker conventional safety from construction and demolition.
- Disturbance caused directly by construction and demolition.
- Disturbance from HGV movements.

The screening exercise considered the overall performance of all the issues listed above in order to remove sub-optimal options, leaving a list of credible options to be taken forward for more detailed assessment during Stage B.



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“Other factors” identified by stakeholders as being of importance, such as cost and stakeholder acceptability, will be considered during Stages B and C of this project.

3.4.4 Screening Methodology

For each attribute information on the relative performance of the long-list options was provided to the OAP. This allowed the OAP to rate the performance of each long-list option against each attribute as being (relatively) good, average or sub-optimal (see Appendix D for details). By inspection, it was then possible to determine which long-list options should be rated overall as sub-optimal on the safety and environmental issues of most importance to stakeholders.

Using this approach required a number of sensitivity analysis to be undertaken to ensure that the outcome of the screening process was robust. These included, for example, reconsidering under the assumption that ILW packages would be transported by rail instead of road.

3.5 Magnox-only Options Screened Out (Scenario 1)

It was found that for Scenario 1, seven options were clearly sub-optimal to the other 22 options, and that this was robust in the sensitivity analysis. These seven options are shown in Table 2 below.

In Table 3 each row represents one possible option and each column is a potential host site. For example, in option 3a there is a store at Berkeley (for Berkeley, Oldbury, Hinkley Point A and some Dungeness A waste packages) and also a store at Bradwell (for Bradwell, Sizewell A and some Dungeness A waste packages).

The options screened out all involve Hinkley Point A packages being transferred for storage elsewhere (to a single site). Fundamentally, this is because Hinkley Point A has the largest number of waste packages of any potential donor sites. The transfer of Hinkley Point A wastes to another location therefore results in relatively high disturbance to local stakeholders and relative to other options under consideration, increased public dose and conventional safety risk from transport, and therefore these options are screened out.

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Table 2. Magnox Only (Scenario 1) Sub-Optimal Options List¹⁴

OPTION	RECIPIENT LOCATION					
	BERKELEY	HINKLEY POINT A	OLDBURY	BRADWELL	DUNGENESS A	SIZEWELL A
3a	Berkeley Oldbury, Hinkley Point A, Dungeness A			Bradwell Sizewell A, Dungeness A		
4a	Berkeley Oldbury, Hinkley Point A			Bradwell Sizewell A	Dungeness A	
4b	Berkeley Oldbury, Hinkley Point A			Bradwell Dungeness A		Sizewell A Dungeness A
5c	Berkeley Oldbury, Hinkley Point A			Bradwell	Dungeness A	Sizewell A

3.6 Credible Option List

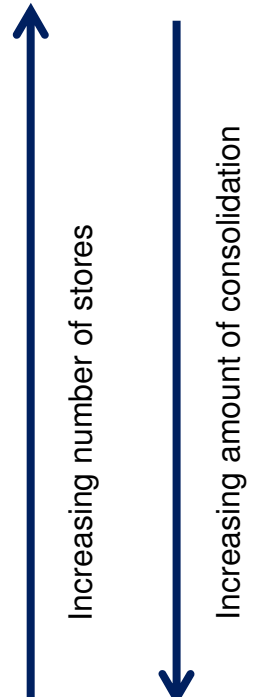
The outcome of the screening assessment identifies the credible option list in Table 3 to be taken forward for more detailed assessment during Stage B. Table 3 also identifies which short-listed options in Scenario 1 are also short-listed in Scenario 2 (see Section 3.1).

This will leave eight options (relevant to England) for assessment (removing the Wylfa variants as discussed in section 3.2.1).

¹⁴ The sub-optimal options also includes the original Wylfa variants of these options (5d, 5e and 6f) which are now removed from further consideration as discussed in section 3.2.1.

Table 3. Credible Options List for Magnox Waste Packages


OPTION ID.	OPTION DESCRIPTION	ILW STORAGE SITES								OPTIONS IDENTIFIED AS CREDIBLE IN SENSITIVITY ANALYSIS INCLUDING EDF ENERGY SITES ¹⁵
		BERKELEY	HINKLEY POINT A	OLDBURY	BRADWELL	DUNGENESS A	SIZEWELL A	TRAWSFYNYDD	WYLFA	
7a ¹⁶	Baseline	Berkeley	Hinkley Point A	Oldbury	Bradwell	Dungeness A	Sizewell A	Trawsfynydd	See main text	Yes
6c	Six Stores – Regional	Berkeley	Hinkley Point A	Oldbury	Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd	See main text	Yes
6b	Six Stores – Regional	Berkeley	Hinkley Point A	Oldbury	Bradwell Sizewell A	Dungeness A		Trawsfynydd	See main text	
6a	Six Stores – Regional	Berkeley Oldbury	Hinkley Point A		Bradwell	Dungeness A	Sizewell A	Trawsfynydd	See main text	Yes
5f	Five Stores – Minimisation of Future Stores	Berkeley Dungeness A	Hinkley Point A	Oldbury	Bradwell Sizewell A Dungeness A			Trawsfynydd	See main text	
5b	Five Stores – Regional	Berkeley Oldbury	Hinkley Point A		Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd	See main text	Yes
5a	Five Stores – Regional	Berkeley Oldbury	Hinkley Point A		Bradwell Sizewell A	Dungeness A		Trawsfynydd	See main text	
4c	Four Stores – Minimisation of Future Stores	Berkeley Oldbury	Hinkley Point A Dungeness A		Bradwell Sizewell A Dungeness A			Trawsfynydd	See main text	



Note that the option ID numbering system reflects the number of stores required to implement the option e.g. Option 4c would require 4 stores whilst Option 6c would require 6 stores.

¹⁵ This tests the alternative assumption that EDF Energy change strategy across their fleet to the use of DCICs.

¹⁶ Option 7a becomes the baseline (previously Option 8a), following removal of the Wylfa variant.



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3.7 Delivery Plan

3.7.1 Stakeholder Engagement Plan

Following stakeholder review this Stage A paper will be revised as appropriate. This revised paper will include a finalised credible options list.

Following completion of Stage A, work will commence on the identification of a preferred option(s). As in Stage A, stakeholders will have an opportunity to provide input into the assessment in a workshop. This is currently planned for July 2013. A paper outlining the preferred option in Stage B is aimed to be published for stakeholder review during November 2013.

Following completion of Stage B, the ability to implement the preferred option(s) will be tested. It is aimed to complete this phase of the project (Stage C) by the end of March 2014. *Note that any implementation phase would require further specific stakeholder engagement such as in relation to planning permissions and regulatory applications.*

3.7.2 Options Assessment Plan (for Stage B)

To compare the remaining options it is proposed that the assessment process first identifies the lead option in each (number of stores) category (this will take into account project cost and schedule factors in more detail, and other local characteristics such as the nature of the roads around the sites). The lead options can then be compared to arrive at a preferred option.

As described in Section 3.2.1 it is proposed that the issue of whether Wylfa ILW packages are sent to Trawsfynydd or not is decoupled from the rest of the assessment, as the arrangements for storage of the waste packages from Wylfa will be decided at some time in the future.



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References

1. EGG08, NDA Guidance for the Production of Business Cases, Rev 7. January 2010.
2. NDA (2012), Insight Into Nuclear Decommissioning. Issue 9.
3. NDA (2011), NDA Strategy, Effective from April 2011, March 2011.

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APPENDIX A - Current Waste Packaging Strategies and Estimated Package Numbers for Magnox and EDF Energy sites in Scope

Site	Waste Packaging Strategy	Best Estimate Package Numbers				3m ³ Equivalent Packages
		DCICs		RWMD Packages		
		Type VI	MOSAIKs [®]	3m ³ Boxes	500 l Drums*	
Berkeley	Conditioning in DCICs	641	250	-	-	891
Bradwell	Conditioning in DCICs	60	113	-	-	173
Dungeness A	Conditioning in DCICs	18	201	-	-	219
Dungeness B	RWMD Containers (Encapsulation)	-	-	0	241	61
Hartlepool	RWMD Containers (Encapsulation)	-	-	0	42	11
Heysham 1	RWMD Containers (Encapsulation)	-	-	0	104	26
Heysham 2	RWMD Containers (Encapsulation)	-	-	0	133	34
Hinkley Point A	Conditioning in DCICs	81	503	-	-	584
Hinkley Point B	RWMD Containers (Encapsulation)	-	-	0	139	35
Oldbury	Conditioning in DCICs	63	79	-	-	142
Sizewell A	Conditioning in DCICs	16	12	-	-	28
Sizewell B**	Conditioning in DCICs & Encapsulation in RWMD Containers	0	104	0	265	171
Trawsfynydd	RWMD Containers (Encapsulation)	-	-	302	2014	806
Wylfa	Conditioning in DCICs	51	0	-	-	51

* Four RWMD 500l drums can be placed into one stillage for storage purposes.

** Figures for EDF are based on 2010 inventory data including future arisings but doesn't include for future life extension arisings for Sizewell B.

APPENDIX B - Long List of Options (Scenario 1)

This scenario involves EDF Energy remaining on their existing strategy and storing their waste separately.

OPTION	RECIPIENT LOCATION							
	BERKELEY	HINKLEY PT A	OLDBURY	BRADWELL	DUNGENESS A	SIZEWELL A	TRAWSFYNYDD	WYLFA
8a	Berkeley	Hinkley Point A	Oldbury	Bradwell	Dungeness A	Sizewell A	Trawsfynydd	Wylfa
Regional								
4a	Berkeley Oldbury, Hinkley Point A			Bradwell Sizewell A	Dungeness A		Trawsfynydd Wylfa	
4b	Berkeley Oldbury, Hinkley Point A			Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd Wylfa	
5a	Berkeley Oldbury	Hinkley Point A		Bradwell Sizewell A	Dungeness A		Trawsfynydd Wylfa	
5b	Berkeley Oldbury	Hinkley Point A		Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd Wylfa	
5c	Berkeley Oldbury, Hinkley Point A			Bradwell	Dungeness A	Sizewell A	Trawsfynydd Wylfa	
5d	Berkeley Oldbury, Hinkley Point A			Bradwell Sizewell A	Dungeness A		Trawsfynydd	Wylfa
5e	Berkeley Oldbury, Hinkley Point A			Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd	Wylfa
6a	Berkeley Oldbury	Hinkley Point A		Bradwell	Dungeness A	Sizewell A	Trawsfynydd Wylfa	
6b	Berkeley	Hinkley Point A	Oldbury	Bradwell Sizewell A	Dungeness A		Trawsfynydd Wylfa	
6c	Berkeley	Hinkley Point A	Oldbury	Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd Wylfa	
6d	Berkeley Oldbury	Hinkley Point A		Bradwell Sizewell A	Dungeness A		Trawsfynydd	Wylfa
6e	Berkeley Oldbury	Hinkley Point A		Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd	Wylfa
6f	Berkeley Oldbury, Hinkley Point A			Bradwell	Dungeness A	Sizewell A	Trawsfynydd	Wylfa
7a	Berkeley	Hinkley Point A	Oldbury	Bradwell	Dungeness A	Sizewell A	Trawsfynydd Wylfa	
7b	Berkeley Oldbury	Hinkley Point A		Bradwell	Dungeness A	Sizewell A	Trawsfynydd	Wylfa

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7c	Berkeley	Hinkley Point A	Oldbury	Bradwell Dungeness A		Sizewell A Dungeness A	Trawsfynydd	Wylfa
7d	Berkeley	Hinkley Point A	Oldbury	Bradwell Sizewell A	Dungeness A		Trawsfynydd	Wylfa
Minimisation of Future Stores								
3a	Berkeley Oldbury, Hinkley Point A, Dungeness A			Bradwell Sizewell A, Dungeness A			Trawsfynydd Wylfa	
4c	Berkeley Oldbury	Hinkley Point A Dungeness A		Bradwell Sizewell A, Dungeness A			Trawsfynydd Wylfa	
5f	Berkeley Dungeness A	Hinkley Point A	Oldbury	Bradwell Sizewell A, Dungeness A			Trawsfynydd Wylfa	
6g	Berkeley Dungeness A	Hinkley Point A	Oldbury	Bradwell Sizewell A, Dungeness A			Trawsfynydd	Wylfa

NB. The site shown in **BOLD** for each option is the receipt location for the ILW, and those sites listed below the donor sites.

APPENDIX C - Long List of Options (Scenario 2)

This scenario involves EDF Energy adopting a strategy using DCICs.

OPTION	RECIPIENT LOCATION							
	BERKELEY	HINKLEY PT	OLDBURY	BRADWELL	DUNGENESS	SIZEWELL	TRAWSFYNYDD	WYLFA
8a (Baseline)	Berkeley	Hinkley Point A & B	Oldbury	Bradwell	Dungeness A & B	Sizewell A & B	Trawsfynydd	Wylfa
Regional								
5b	Berkeley Oldbury	Hinkley Point A & B		Bradwell Dungeness A only		Sizewell A & B Dungeness A & B	Trawsfynydd Wylfa	
6a	Berkeley Oldbury	Hinkley Point A & B		Bradwell	Dungeness A & B	Sizewell A & B	Trawsfynydd Wylfa	
6c	Berkeley	Hinkley Point A & B	Oldbury	Bradwell Dungeness A only		Sizewell A & B Dungeness A & B	Trawsfynydd Wylfa	
6e	Berkeley Oldbury	Hinkley Point A & B		Bradwell Dungeness A only		Sizewell A & B Dungeness A & B	Trawsfynydd	Wylfa
7a	Berkeley	Hinkley Point A & B	Oldbury	Bradwell	Dungeness A & B	Sizewell A & B	Trawsfynydd Wylfa	
7b	Berkeley Oldbury	Hinkley Point A & B		Bradwell	Dungeness A & B	Sizewell A & B	Trawsfynydd	Wylfa
7c	Berkeley	Hinkley Point A & B	Oldbury	Bradwell Dungeness A only		Sizewell A & B Dungeness A & B	Trawsfynydd	Wylfa
Minimisation of Future Stores								
5g	Berkeley Oldbury Dungeness A & B	Hinkley Point A & B		Bradwell Dungeness A only		Sizewell A & B	Trawsfynydd Wylfa	
5h	Berkeley Oldbury	Hinkley Point A & B Dungeness A & B		Bradwell Dungeness A only		Sizewell A & B	Trawsfynydd Wylfa	
6h	Berkeley Dungeness A & B	Hinkley Point A & B	Oldbury	Bradwell Dungeness A only		Sizewell A & B	Trawsfynydd Wylfa	
7e	Berkeley Dungeness A & B	Hinkley Point A & B	Oldbury	Bradwell Dungeness A only		Sizewell A & B	Trawsfynydd	Wylfa

APPENDIX D - Summary of Screening Assessment (Scenario 1)

For the purposes of option screening (reducing the long-list of options to a short-list) only the safety and environment Value Framework attributes were considered. Only those factors detailed in the table for safety and environment were used in the screening process (as these were identified as being of significance to stakeholders).

During Stage B of the project, assessment will be carried out on the remaining Value Framework attributes, these being, Hazard Reduction, Security, Socio-economic Impact and Cost.

The options assessment presented in this table is based upon a Red, Amber, Green scoring system of relative option performance on each of the factors considered to be of significance to stakeholders. The descriptions below provide more detail on the scoring system applied:

Red	The option was either the worst performing option (or performed similarly to the worst) on a particular factor.
Amber	The option was neither one of the best or worst performing options on a particular factor. Note that the Amber score was not used for all factors as for some factors there were only two clear groups of options in terms of performance.
Green	The option was either the best performing option (or performed similarly to the best) on a particular factor.

It should be noted that none of the options performed at a level for any of the factors assessed which would be considered to be unacceptable by Magnox. This assessment of acceptability took account of relevant regulatory limits and also company derived working limits. For example the assessment of the acceptability of the worker dose uptake associated with an option took account of Office of Nuclear Regulation set Basic Safety Limits and Objectives and also Magnox company dose limits.

OPTION (See Appendix A)	Value Framework Attribute - Safety					Value Framework Attribute - Environment		
	Public Individual Dose from the Transport of Rad. Waste	Public Collective Dose from the Transport of Rad. Waste	Worker Collective Dose	Public Conv. Safety – Transport of Rad. Waste and C&D Materials	Worker Conv. Safety – C&D	Disturbance Caused Directly by C&D (site years)	Disturbance Caused by HGV Movements – Transport of Rad. Waste and C&D Materials (Total No. of HGVs)	Disturbance Caused by HGV Movements – Transport of Rad. Waste (Max. No. of HGVs to a Single Site)
3a	Red	Red	Red	Red	Green	Green	Red	Red
4b	Red	Red	Red	Red	Green	Green	Red	Red
4a	Amber	Amber	Red	Red	Green	Green	Red	Red
5e	Red	Red	Red	Red	Amber	Amber	Red	Red
5c	Amber	Amber	Red	Red	Amber	Amber	Red	Red
5d	Amber	Amber	Red	Red	Amber	Amber	Red	Red
6f	Amber	Amber	Red	Red	Amber	Amber	Red	Red
Options above this row are those which were screened out								
5b	Red	Amber	Amber	Amber	Amber	Amber	Green	Green
5f	Red	Amber	Amber	Amber	Amber	Amber	Green	Green
5a	Amber	Green	Amber	Green	Amber	Amber	Green	Green
4c	Red	Amber	Amber	Green	Green	Green	Green	Green
6g	Red	Amber	Amber	Amber	Amber	Amber	Amber	Green
6c	Red	Amber	Amber	Amber	Amber	Amber	Green	Green
6e	Red	Amber	Amber	Amber	Amber	Amber	Green	Green
6a	Amber	Green	Green	Amber	Amber	Amber	Amber	Green
6b	Amber	Green	Green	Amber	Amber	Amber	Amber	Green
6d	Amber	Green	Green	Green	Amber	Amber	Amber	Green
7c	Red	Amber	Amber	Amber	Red	Red	Amber	Green
7a	Amber	Green	Green	Amber	Red	Red	Amber	Green
7d	Amber	Green	Green	Amber	Red	Red	Amber	Green
7b	Green	Green	Green	Amber	Red	Red	Amber	Green
8a	Green	Green	Green	Amber	Red	Red	Red	Green