Nuclear Decommissioning Authority

Optimising the number and location of FED Treatment (Dissolution) Facilities in Magnox Limited

Credible Options
Summary Paper

May 2013

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1 Introduction

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[1]. The consolidation of Fuel Element Debris (FED) treatment by dissolution offers a significant opportunity of this nature.

Therefore, Magnox Limited (hereafter known as 'Magnox') is reviewing the case for consolidating the treatment of Magnox FED through the use of shared facilities[2]. Specifically, the project aim is:

> ***"To establish the most appropriate location or locations for treating Fuel Element Debris (FED) currently stored at Hinkley Point A, Oldbury and Sizewell A sites."***

This study is being undertaken following the NDA's Strategy Management System (SMS). 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).

This document presents a summary of the findings in Stage A so far. The Credible Options list will be finalised following stakeholder review of this document.

2 Background

Fuel Element Debris (FED) consists of the splitters or lugs[3] removed from Magnox fuel elements before the spent fuel is sent to Sellafield for reprocessing. The fuel casing, including the splitters / lugs, used in Magnox reactors is a magnesium alloy. Although the specific alloy used is non-oxidising (from which the Magnox reactors derive their name), magnesium is inherently a reactive metal.

The baseline plan for FED is for each site to manage their own wastes on their own site. For each of the three sites within the scope of this study, treatment by dissolution was identified as the preferred approach within site-specific Best Practicable Environment Option (BPEO) studies. In each case, the preferred option was found to be robust within the sensitivity analyses undertaken.

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

2 Even outwith any consolidation opportunities, some review of the location of dissolution facilities is required to address the Environment Agency's optimisation (Best Available Techniques (BAT) requirements.

3 Essentially "fins" that optimised in-reactor fuel element cooling during generation.

Through treatment with acid, FED dissolution produces a non-reactive waste, reducing the solid waste volume by more than a factor of 20 whilst retaining more than 85% of the radioactivity in residues that will be managed along with other ILW wastes at the site.

The reduction in solid waste volumes has the knock-on effect of reducing the size of store required for interim storage of ILW though it does lead to some discharges of radioactive and non-radioactive by-products to the environment. All such discharges have to be both minimised and authorised under the environmental permitting regulations.

3 Scope

This study only considers which are sites are the best locations to treat FED by dissolution and does not consider the choice of technology for doing so i.e. the type of any new dissolution plant.

The FED in scope is that currently stored at Hinkley Point A, Oldbury, and Sizewell A (Table 1).

Table 1. Summary of Waste Considered to be in Scope

Site	Raw Magnox FED (tonnes)[4]
Hinkley Point A	261
Oldbury	144
Sizewell A	134

Bradwell site FED is not included in the scope of the study because Bradwell is well-advanced in implementing dissolution of its own FED on its own site in line with its accelerated Care & Maintenance programme. Dungeness A FED is also not included as the site has recently completed its own dissolution on-site.

The baseline plan for the remaining sites with a significant amount of FED waste, namely Berkeley, Hunterston A and Trawsfynydd, is packaging for long-term storage and disposal without the prior application of dissolution. Dissolution is not considered to be an appropriate treatment for FED at these sites due to progress in the construction of interim waste storage facilities and because much of the FED currently stored at Berkeley and Hunterston is mixed or contaminated with other waste types, making dissolution technically difficult.

Other nuclear operators either do not generate FED in the first instance (e.g. EDF Energy), or else the FED that they hold is unlikely to be suitable for treatment by dissolution (e.g. Sellafield). Therefore, no FED generated or held by other operators falls within the scope of this study.

[4] Excluding vault sludges. In the case of Hinkley Point A, this would add around 36 tonnes.

4 Long-List of Options

A long-list of 14 options was generated within five high level categories:

- Baseline option – each site has its own treatment plant.
- Regional options – transfers may happen between sites on a regional basis.
- Consolidation of lower volume FED sites only (i.e. Oldbury and Sizewell A FED processed at the same location).
- Minimisation of future plants (not included in categories above) – two new plants.
- Minimisation of future plants – one new plant.

Most of the options involve the construction and use of new plants that do not yet exist, these being located at one or more of the Hinkley Point A, Oldbury, Sizewell A and Dungeness A sites. In some options, FED from Sizewell is transferred for processing at the existing dissolution plant at Dungeness A.

These options were discussed at a stakeholder meeting on 12th - 13th February 2013[5]. Stakeholders were given the opportunity to add further options and a number of suggestions were made[6]. Magnox has subsequently considered these suggestions, resulting in the addition of one further option to the list: that Hinkley Point A has its own new plant for treating its own FED and that there is a new plant at Dungeness A for treating FED from Sizewell A and Oldbury.

There are two potential long-list options that have been suggested by stakeholders which are not being taken forward but which require some explanation here. These are:

- Use of the Bradwell dissolution plant (currently under construction) as a single facility option; and
- Use of the existing Dungeness A carbonic acid plant as a single facility option.

The first of these would involve the Bradwell site continuing to undertake operations after its planned entry into Care and Maintenance (C&M). Magnox does not wish to pursue this option as the undertaking of active operations over a number of years is not consistent with the concept of C&M. In addition whilst the short-term impacts of discharges have been deemed to be acceptable (and the relevant permit obtained), the Bradwell site is sub-optimal in terms of longer term environmental impacts, as would occur if Bradwell was used as a shared plant. For this reason, the Environment Agency has stated that the continued use of the Bradwell site in this way would

[5] Stakeholders at this meeting included Site Stakeholder Group / Local Community Liaison Committee members; representatives from local authorities; and the regulators.
[6] Details of the additional options suggested and Magnox's consideration of these are available on request.

require strong justification. It is intended that components from the Bradwell dissolution plant will be re-used elsewhere where practicable.

The use of the existing Dungeness A plant as a single facility is not being taken forward by Magnox due to limitations on its throughput rate: to process the FED from all three potential donor sites would take circa 40 years and again require sites to be operating within their C&M periods. Therefore, within the long-list options the use of the Dungeness A carbonic plant is considered for Sizewell A FED only; this is because it is a relatively small volume which is located in the same broad region of the UK.

5 Optimisation Factors

In this optimisation study, it is necessary to determine the best overall balance of all relevant factors. This is being done in two phases. In the first phase (Stage A), safety and environmental factors are being used to eliminate clearly sub-optimal options. This is the subject of this paper. In the next phase (Stage B), issues such as cost, implementation risk, operability and so on will be taken into account when comparing the remaining options. This will include issues required to be considered under the NDA's Value Framework process. Note that it is a working assumption that the construction of fewer plants would result in a reduced cost of FED treatment.

It is considered that all of the relevant safety and environment factors relate to three issues: construction; transport of radioactive waste; and the suitability of the receiving environment for discharges. These are discussed in turn below.

The options that involve more new dissolution plants involve a larger amount of construction. This in turn leads to increased:

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

However, options which involve fewer new dissolution plants require more transport of radioactive wastes, leading to increased:

- Public and worker radiation exposure (note that implementation none of the options would give rise to doses which would challenge relevant legal limits)
- Risk of accident
- Carbon dioxide emissions

Options which involve moving FED from the site on which it originated for processing elsewhere (e.g. to reduce the number of new plants required) have the potential to

result in lesser or greater environmental impacts as a result of radioactive or chemical discharges, depending on the receiving environment.

In order to achieve the best overall balance of these issues referred to above, it is necessary to decide which of these should be most important in the decisions to be made.

6 Option Screening

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 issues considered most important by stakeholders were:

- Public individual and collective dose from the transport of radioactive waste.
- Public individual and collective dose from radioactive discharges.
- Worker collective dose[7].
- Public conventional safety from transport of radioactive waste, and construction and demolition materials.
- Worker conventional safety – construction and demolition.
- Disturbance caused directly by on-site construction and demolition activities.
- Disturbance by HGVs.
- Nitrates discharges to the marine environment.
- Sensitivity of the locality to emissions.

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.

In summary, the options rejected at this stage all involve transferring Hinkley Point A's FED to another location. Otherwise all other options remain.

The reasons for options involving the transfer of Hinkley Point A's FED elsewhere being rejected is principally because at Hinkley Point A the largest volume and most radioactive FED is located. All other factors being equal it is preferable to move waste from sites with smaller volumes to sites with larger volumes.

In addition, the aquatic environment at Hinkley Point A is relatively well suited to the receipt of discharges from the FED treatment process. For example, the coastal water at Hinkley Point A has good dispersion characteristics. Therefore, from this perspective it also makes sense for the Hinkley Point A FED to remain where it is currently located rather than to transfer it elsewhere.

[7] For use in screening as a surrogate for industrial safety.

7 Credible Options

The remaining options are given in Table 2. In this table each row represents one possible option and each column is a potential host site. For example, in option C there is a new treatment plant at Hinkley Point A which would be used to treat FED from that site and also from Oldbury, and another new treatment plant at Sizewell A. Option H is the same as regards Hinkley Point A and Oldbury, but in this option Sizewell A FED would be transferred for processing at the existing treatment plant at Dungeness A. As a further example, in option E there is one new plant at Hinkley Point A and another new plant at Dungeness A, in the latter case that plant being used to process FED from the Oldbury and Sizewell A sites.

The baseline option of each site treating its own FED remains (option A), and one option remains that involves all FED in scope being treated at a single location (option I). In between these, there are a number of options that variously include elements of regional and cross-regional transfer; low volume consolidation; and use of the existing plant at Dungeness A.

Table 2. Credible Options List

Option ID	Option Type	Number of Locations	Number of New Plants	Dissolution Facility Host Sites			
				Hinkley Point A	Oldbury	Sizewell A	Dungeness A
A	Baseline	Three	Three	Hinkley Point A FED	Oldbury FED	Sizewell A FED	N/A
B	Regional	Three	Two	Hinkley Point A FED	Oldbury FED		Sizewell A FED (using existing plant)
C	Regional	Two	Two	Hinkley Point A FED Oldbury FED		Sizewell A FED	
D	Cross-regional	Two	Two	Hinkley Point A FED Sizewell A FED	Oldbury FED		
E	Cross-regional	Two	Two	Hinkley Point A FED			Sizewell A FED & Oldbury FED (using new plant)
F	Cross-regional	Two	Two	Hinkley Point A FED	Oldbury FED Sizewell A FED		
G	Cross-regional	Two	Two	Hinkley Point A FED		Sizewell A FED Oldbury FED	
H	Regional	Two	One	Hinkley Point A FED Oldbury FED			Sizewell A FED (using existing plant)
I	Cross-regional	One	One	Hinkley Point A FED Oldbury FED Sizewell A FED			

8 Way Forward

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). The proposed approach is to compare different sub-sets of the credible options in a structured optioneering assessment. 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.