Magnox

NDA Nuclear Decommissioning Authority

Intermediate Level Waste (ILW) Storage and Fuel Element Debris (FED) Treatment Optimisation Study

What is the review about?

A key part of decommissioning the Magnox sites is dealing with the waste. There are many diferent types of radioactive waste and this review is about intermediate level waste (ILW).

In general ILW will be retrieved, processed and packaged for interim storage and eventual disposal. One type of ILW, fuel element debris (FED) is suitable for treatment by dissolution. This process is used to reduce the volume packaged for interim storage and disposal as ILW.

This review aims to:

- Establish which sites are the most appropriate locations for interim storage of ILW packages from Berkeley, Bradwell, Dungeness A, Hinkley Point A, Oldbury and Sizewell A

- Establish the most appropriate location or locations for treating FED currently stored at Hinkley Point A, Oldbury and Sizewell A.

Why undertake a review?

There is an existing plan that would see an ILW store built at each site and also a FED treatment plant where such waste exists. This approach is now being reviewed because:

- Following wide public consultation, the Nuclear Decommissioning Authority (NDA) published its strategy in 2011 which said: "…we will investigate opportunities to share waste management infrastructure across the estate and with other waste producers where we can see beneft."

- Consolidation of facilities has the potential to offer benefts in safety, environmental and economic terms.

- Magnox has an obligation to reduce the volume of waste for disposal in accordance with good environmental practice and to deal with waste in such a way that ensures protection of the public and environment.

- Experience has been gained building stores at a number of sites. Learning from these projects is now being applied before committing to further construction.

How is the review being undertaken?

Stage A - defne the credible options:

Following the input of stakeholders, a list of eight options for the storage of ILW and nine options for the treatment of FED was prepared and published by the NDA in May 2013 for public comment. More than 50 responses were received. Feedback from stakeholders was taken into account in the next stage of the project.

Stage B - identify preferred options:

The options were assessed and further stakeholder engagement feedback was incorporated. This included a preference from stakeholders for regional solutions as well as an aspiration to use rail for transport where possible.

A preferred integrated option has now been identifed and is being published for public comment.

Next Steps - prepare for implementation:

Following public feedback, if the NDA decides to proceed work will begin in 2014 to prepare for implementation. This will include applying for relevant planning permission and regulatory consents.

Movement of waste is not expected to begin for a number of years.


Fuel Element Debris (FED)


Type VI Ductile Cast Iron Container (DCIC)

How can I provide feedback?

A stage B paper, outlining the preferred options, will be published at www.nda.gov.uk and comments are welcome until 31 January 2014. Feedback can be submitted online or by writing to: Magnox ILW and FED review, Nuclear Decommissioning Authority, Herdus House, Westlakes Science & Technology Park, Moor Row, Cumbria CA24 3HU.

Visit: www.youtube.com/magnoxsites to learn more about the review

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Storage of Packaged Intermediate Level Waste (ILW)

What is ILW?

ILW is radioactive waste with radioactivity levels exceeding the upper boundaries for low level waste (LLW). ILW differs from high level waste (HLW) as it does not require heat generation to be taken into account when considering interim storage and disposal.

ILW of various types have arisen during the generation phase of the Magnox sites' lifecycle. These waste streams have generally accumulated on the sites in their raw form, and are stored within tanks and vaults. Examples of ILW to be managed in the near-term

include:

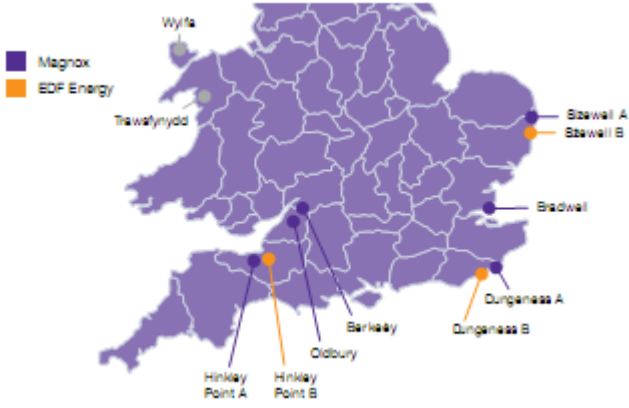
- Fuel element debris (FED) arising from the desplittering of fuel elements
- Miscellaneous activated components arising from the maintenance and replacement of items used in the reactors
- Miscellaneous contaminated items eg equipment and materials from the ponds and fuel route

• Sludges and ion exchange resins resulting from the fltration and treatment of liquids, eg from fuel cooling ponds

• Cartridges and flters used in fuel ponds and active effuent water treatment

• Sand and gravel used in the site effuent treatment plants and for drainage in the bottom of waste storage vaults.

ILW under consideration



The main focus of this study is the packaged ILW from the six Magnox sites in England. As Wylfa is still in its generation phase this site has been excluded from the study at this time.

Trawsfynydd has an ILW store but uses a different packaging strategy and is also not considered further.

The opportunity for co-storage with EDF Energy sites has been considered as part of this study.

What is the strategy for Magnox ILW?

In general ILW will be retrieved, processed and packaged for interim storage. There is currently no permanent disposal route available for ILW. Packaged ILW will be transferred from the sites when the geological disposal facility (GDF) becomes available (currently planned from 2040).

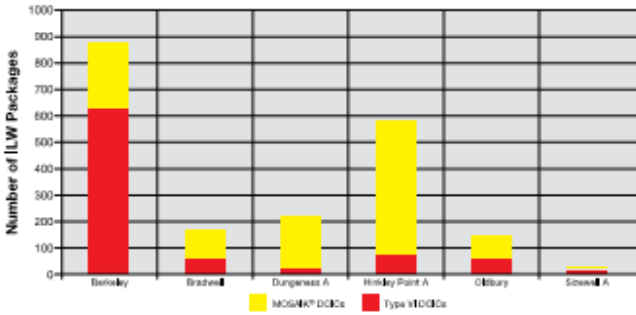
Treatment of waste can also be undertaken to reduce the volume packaged for interim storage and disposal as ILW. One example of this is the treatment of FED by dissolution.

How is Magnox ILW packaged?

Two types of ductile cast iron containers (DCICs) will be used for the interim storage and eventual disposal of ILW from Bradwell, Berkeley, Dungeness A, Hinkley Point A, Oldbury and Sizewell A.

Type VI containers • cuboidal • about 2.5 m3 of waste in each • about 25 tonnes when full	

MOSAIK® containers • cylindrical • about 0.5 m3 waste in each • about 10 tonnes when full	



The anticipated number of ILW packages to be created across the six Magnox sites in England is shown in the figure above.

How are Magnox ILW packages stored?

A DCIC itself incorporates a signifcant degree of shielding and as such a facility for its storage requires relatively little additional shielding and is simple in terms of construction.

The ILW stores to be used within Magnox for the interim storage of DCICs are constructed in accordance with industry guidance and best practice and have a design life of 150 years. In addition they are designed to an external dose design target of 20 µSv per year to the

public (which represents about one per cent of average background radiation doses) and it is currently expected that actual doses will be substantially lower than this.

Bradwell has finished constructing an ILW store and Berkeley is underway with construction. Future stores to be built across the Magnox sites will follow a similar design.

What is the plan for EDF Energy ILW?

EDF Energy sites are currently operational. EDF Energy's strategy for operational ILW is to retrieve and package it ready for disposal as soon as reasonably practicable after the end of generation.

At most EDF Energy sites the current packaging strategy is to produce encapsulated packages.

At EDF Energy's Sizewell B site, the use of DCICs is proposed for ILW resins.

It is currently proposed that all of the packaged ILW is to be held on site in purpose-built interim storage facilities. However, the differences in packaging approaches affect ILW storage facility 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 is unlikely to be practicable or optimal.

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Treatment of Fuel Element Debris (FED)

What is FED?

Fuel elements

Magnox reactors are graphite moderated

Fuel elements were placed into fuel channels within the reactor core

Fuel elements were designed to stack and retain fission products

Fuel cans are made of Magnox - magnesium alloy (greater than 99 per cent magnesium)

FED production

Splitter blades were removed to facilitate consignment to Sellafield within fuel flasks

This was done in the cooling ponds by a process called desplitering

The FED which resulted was transferred to vaults on the sites

Design of fuel element

Magnox metal

splitter blades

top end fitting

nose cone

Also with Magnox FED

Nimonic springs

Nimonic springs are contained in the top end fitting and could be removed and discarded with FED

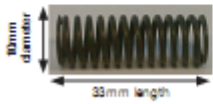
Fuel fragments

Very occasionally damage to the fuel during the desplitting process resulted in small pieces of fuel being transferred to the FED vaults with the Magnox FED

Thermocouple wires

Thermocouples used to monitor element temperature in reactor were disposed of with FED

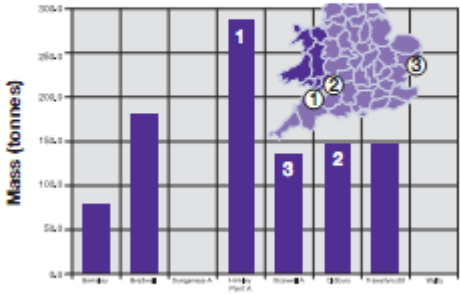
Nimonic springs



It is a project assumption that all of these items will be segregated prior to treatment or transport

How much FED is there and where is it stored?

Magnox FED in England and Wales



Approx 575 tonnes at Hinkley Point A, Sizewell A and Oldbury

The FED in the scope of this study is currently stored at Hinkley Point A, Oldbury, and Sizewell A (approximately 575 tonnes).

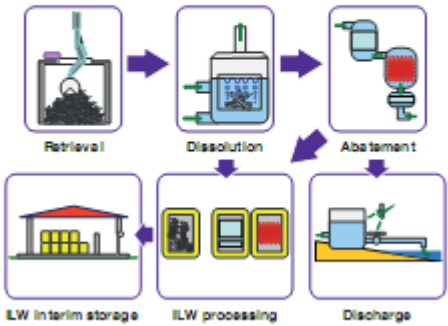
Bradwell site FED is not included in the scope of the study because Bradwell is well-advanced in implementing dissolution of its own FED on its own site in line with its decommissioning programme. Dungeness A FED is also not included as the site has recently completed its own dissolution on-site. The baseline plan for the remaining sites with a significant amount of Magnox FED waste, namely Berkeley and Trawsfynydd, is packaging for long-term storage and disposal without the prior application of dissolution. In general dissolution is not considered to be an appropriate treatment for FED at these sites due to progress already made in the construction of interim waste storage facilities and, in the case of Berkeley, because much of the FED is mixed or contaminated with other waste types thereby making dissolution technically difficult.

What is the strategy for Magnox FED

The strategy for Oldbury, Hinkley Point A and Sizewell A FED is retrieval and treatment by dissolution. This involves dissolving the magnox metal within an acid solution with the bulk of the radioactivity retained within the residue and secondary wastes. The residue, secondary wastes and non-magnox components are to be packaged in containers suitable for interim storage and eventual disposal.

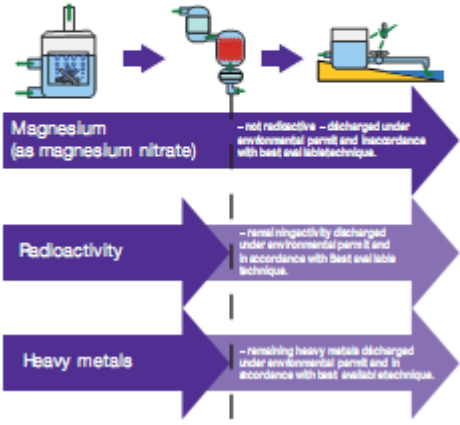
How is FED treated?

Dissolution process overview



What does the abatement plant do?

This plant filters the effluent from the dissolution plant before being discharged



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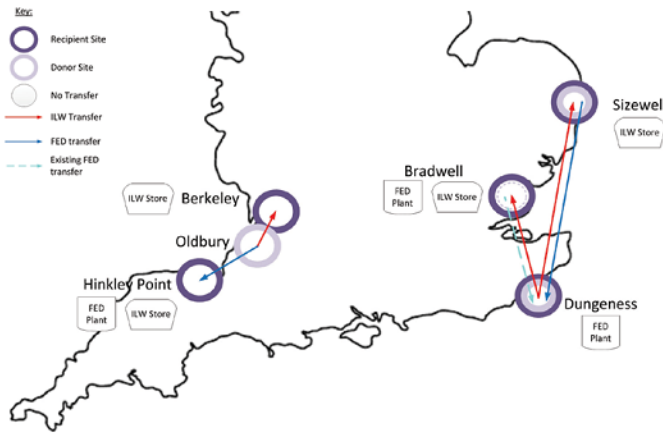
The Preferred Integrated Option

Following stakeholder engagement and assessment of the credible options, comments are sought on the following preferred option for the location or locations for interim storage of intermediate level waste (ILW) packages and treatment of fuel element debris (FED).



This outcome is preferred as it is considered to:

- Make best use of existing facilities and avoids unnecessary construction.
- Ensure that there is a balance of development across the sites.
- Reduce overall environmental impact.

• Save approximately £90M whilst maintaining the highest safety standards.

• Provide opportunities for future consolidation of ILW package interim storage with EDF Energy.

Overall, it is considered that the advantages of the preferred integrated solution outweigh the disadvantages (such as the transport of radioactive waste on public roads), especially when potential mitigations are taken into account.

What does this mean for each site?

	Berkeley • Receive Oldbury ILW packages for interim storage in the existing Berkeley ILW store.	• ILW packages would be transported from Oldbury by road using ~ 100 lorries.

	Bradwell • Receive Dungeness A ILW packages for interim storage in the existing Bradwell ILW store.	• ILW packages would be transported from Dungeness A via rail, using ~ 100 lorries between the railhead and the site.

	Dungeness A • No construction of an ILW store at Dungeness A – interim storage of Dungeness A ILW packages at Bradwell and Sizewell A. • Dungeness A ILW packages would be Transported to Bradwell and Sizewell A via rail, using ~ 120 lorries between the railhead and the site.	• Receive and process Sizewell A FED using the existing Dungeness A dissolution plant. • FED would be transported from Sizewell via rail, using ~ 60 lorries between the railhead and the site.

	Oldbury • No construction of an ILW store Oldbury – interim storage of Oldbury ILW packages at Berkeley. • Oldbury ILW packages would be transported to Berkeley by road using ~100 lorries.	• No construction of a FED treatment plant at Oldbury – processing of Oldbury FED at Hinkley Point A. • Oldbury FED would be transported to Hinkley Point A by road using ~ 70 lorries.
	Hinkley Point A • Construction of a new ILW store for the interim storage of Hinkley Point A ILW packages. • Opportunity for shared storage with the B site (if EDF Energy changes packaging strategy).	• Receive and process Oldbury FED using the Hinkley Point A dissolution plant (to be constructed). • FED would be transported from Oldbury by road using ~ 70 lorries.

	Sizewell A • No construction of FED treatment plant at Sizewell A – processing of Sizewell A FED at Dungeness A. • Sizewell A FED would be transported to Dungeness A via rail, using ~ 60 lorries between the site and the railhead. • Receive Dungeness A ILW packages for interim storage in the Sizewell A ILW store (to be constructed).	• ILW packages would be transported from Dungeness A via rail, using ~ 20 lorries between the railhead and the site. • Opportunity for shared storage with the B site (Sizewell B has some resins packaged in Mosaiks®).

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Transport of Radioactive Material

In the UK, over half a million shipments of radioactive materials of all kinds are transported every year. These consignments, which are carried by road, rail, sea, air and inland waterway, can range from smoke detectors and cobalt sources for medical uses, to nuclear fuel cycle materials for electricity generation.

The international transport of radioactive materials is governed by a stringent regulatory regime, which includes standards, codes and regulations which have been continuously revised and updated.

Package types used for transporting radioactive material

Safety is provided principally by the package to protect the public, worker and the environment against the effect of radiation and release of the radioactive contents. Packages used for transport of radioactive materials are defned by the International Atomic Energy Agency (IAEA):

NDA strategy has a preference for the use of rail over road where practicable. This is taken into account in the

choice of container for any transport of radioactive waste. The regulations set the criteria for package design according to both the activity and the physical form of the radioactive material they may contain in a proportionate manner. Because safety depends primarily on the package, the Regulations set out several performance standards and test procedures to demonstrate compliance with the required performance standards.

Packages have to take into account the different conditions of transport defned by the IAEA:

- Routine conditions likely to be encountered under everyday operations (incident free)
- Normal conditions considered to be “minor mishaps” or incidents (eg load shifting during braking)
- Accident conditions where the package is subject to incidents or accidents.

RADSAFE

In the unlikely event of an accident, transport emergency arrangements are in place. For Magnox, this is provided via RADSAFE.

RADSAFE is a mutual support scheme which provides 24 hour expert assistance to the emergency services following an incident involving the transport of radioactive material on the public highway or the rail network. It achieves this by:

- Providing early information to the emergency services at the scene of the event
- Responding to the event with technical support within a target time
- Establishing clear responsibility for clean-up of the event
- Establishing a 24 hour national notifcation telephone number
- Establishing a communication route for expert advice and technical support
- Establishing a framework for media support
- Providing consignment owner site support.

How might Magnox FED be transported?

FED which has experienced a longer period of radioactive decay (ie older) and is therefore lower in activity has already been transferred from Bradwell to Dungeness A in an industrial package. This transfer has

demonstrated the safety and secure transportation of FED between Magnox sites.

FED which has experienced a shorter period of radioactive decay and is therefore higher in activity would be transported in a Type A package.

How might Magnox ILW packages be transported?

Magnox ILW will be packaged into containers suitable for fnal disposal. The ductile cast iron containers (DCICs) to be used at Bradwell, Berkeley, Dungeness A, Hinkley Point A, Oldbury and Sizewell A are also transport containers. Type VI containers are an example of an industrial package. Mosaik® containers can be either industrial packages or Type B packages.