

Exotic Fuels and Nuclear Materials - Dounreay

Preferred Option (Gate B)

February 2013

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Executive Summary

A number of different forms of nuclear fuels and materials are currently safely and securely stored on the Dounreay site. Some of these fuels and materials require enhanced site security arrangements. While these are already in place, they are expensive to maintain in the long term. The materials currently stored at Dounreay include unirradiated plutonium and high enriched uranium bearing fuels. For brevity, these are termed Dounreay “exotics”.

The Energy Act (2004)¹ requires us to have a strategy to safely and securely manage exotics in the most practical and cost effective way. If these materials are retained at Dounreay new stores would be required to replace the current stores which are reaching the end of their design life. New facilities are either under construction or planned at Sellafield, and as such it is therefore a good time to consider management options for this material.

In February 2012 the NDA published a credible options paper for the management of the Dounreay exotic material². The options considered can be summarised as:

- To continue to manage the material at Dounreay, which is the current baseline plan
- To transport the exotics to Sellafield for management.

The credible options paper identified a number of advantages in transporting the exotics to Sellafield but at that time further discussion with regulators and stakeholders was required to underpin the feasibility of this option and to consider stakeholder views. These discussions have concluded and the NDA now considers movement of the exotics to Sellafield for long term management alongside the Sellafield fuels inventory to be the preferred option.

¹ http://www.legislation.gov.uk/ukpga/2004/20/pdfs/ukpga_20040020_en.pdf

² <http://www.nda.gov.uk/documents/upload/Exotic-Fuels-and-Nuclear-Materials-Dounreay-Credible-Options-February-2012.pdf>

1 Background

1.1 Dounreay Exotic fuels and nuclear materials

There are many different forms of nuclear fuels and materials currently safely and securely stored on the Dounreay site. Some of it is unirradiated and some has been irradiated in experimental reactors since the 1950s. In total, the fuel inventory amounts to the order of 100 tonnes of these materials which require enhanced site security arrangements. While these are already in place, they are expensive to maintain in the long term. The exotics material is a subset of the fuel inventory, comprising around 26 tonnes of the fuel inventory and was described in more detail within the credible options paper¹.

Whilst the exotics remain on site in their current form, Dounreay will retain the highest level of security categorisation, with the attendant security requirements. In around 10-15 years, many of the storage facilities will need to be replaced with new facilities which usually take 8-10 years to design, construct, and commission. As a result it is now timely to consider the management options.

1.2 Objective

There are two strategic themes, Spent Fuels and Nuclear Materials, within our Strategy³ which are relevant in the consideration of the management of the exotics. Within our Strategy there are several key statements of principle which underpin our approach, the foremost of which is:

“...we will ensure the continued safe management of these fuels, maximising opportunities to use existing facilities where value to the UK taxpayer can be secured. This may involve consolidating material at one or more locations for storage and treatment, and storage may be needed for several decades”.

The principle objective is to ensure the future safe and secure management of exotics currently stored at Dounreay in a cost effective manner. Achieving this requires the following criteria to be met:

- The management of high security classification exotics continues to be carried out safely and securely, while providing the taxpayer with value for money.
- The management of these exotics does not compromise the planned hazard reduction programme at any impacted sites.

³ NDA Strategy, April 2011



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- Alternative strategies for processing the exotics are similar or better in terms of cost, hazard reduction and environmental benefit to those originally planned at Dounreay.
- If applicable, there are proven means of transporting the exotics wherever the destination, for example internal site transfers or external site to site transfers.

1.3 Policy Context

None of the exotics held at Dounreay are considered to be waste, rather they are spent fuels or nuclear materials, and all are currently potentially recyclable. The recently published Scottish Higher Activity Waste Policy (2011) specifically exempts spent nuclear fuels held in Scotland (sections 1.13 and 2.03.04).

Any matter of national security, such as the safe and secure management arrangements for certain nuclear materials in the UK is a matter for the UK Government and is not a devolved matter.

2 Preferred Option

2.1 Options Analysis

The options analysis conducted as part of the credible options paper has been reviewed. Appendix 3 documents the output of the credible options paper and brings the analysis up to date, detailing the rationale for any changes that have been made.

In the analysis we consider the credible options for each of the groups of nuclear material (see Appendix 1) separately. However it should be recognised that the principle benefit of moving materials from Dounreay would be the reduction in security classification of the Dounreay site, and associated cost reductions, which can only be achieved if all these exotics leave the site.

The credible options paper identified two high level options for the future management of exotics which deliver the objective:

- To continue to manage the exotics at Dounreay, which is the current baseline plan
- To transport the exotics to Sellafield for management

Each of the options was considered against the NDA Value Framework⁴ criteria, within the credible options paper¹, demonstrating that the impact of moving the

⁴ <http://www.nda.gov.uk/stakeholders/newsletter/value-framework.cfm>



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exotics to Sellafield will be minor, being a relatively small increase in the scope of work for the site, whilst offering significant security, hazard reduction and cost benefits at Dounreay. This analysis has been reviewed and remains valid as the basis for making the decision on a preferred option, and so is not repeated within this document.

2.2 Stakeholder Views

NDA received 13⁵ sets of comments in response to the credible options paper. A spectrum of views were expressed ranging from those who felt strongly that the exotic material should remain on and be managed at Dounreay to those who felt strongly that it should be moved to Sellafield.

Of those that opposed any movement of exotic material to Sellafield the prime concern was the safety of transporting the material. This concern was echoed by many of those advocating a move of material to Sellafield, some of whom expressed a preference for the mode of transport that should be employed.

It was also noted that several stakeholders expressed the view that more time should have been allowed for engagement and additional consultation should take place with local communities before any decision is taken.

The NDA has undertaken a programme of engagement with key stakeholders on our preferred option for the Dounreay exotics as part of wider stakeholder engagement on management of Spent Fuels and movement of Nuclear Materials. In accordance with our Strategy, the NDA will continue to undertake such engagement as appropriate as the preferred option for the Dounreay exotics is implemented.

2.3 Transportation

Since the credible option paper was published further work has been undertaken to determine the most appropriate transport modes. The potential transport modes have been discussed in detail with the transport and security regulators within the Office for Nuclear Regulation (ONR), and a consensus on the most suitable modes and logistical arrangements has been reached. All transports will be the subject of regulation by the Office for Nuclear Regulation.

The number of transports will depend on the details of how the material can be loaded while complying with regulatory requirements but it is expected that there would be in the region of 30-40 journeys over a period of around 6 years, commencing probably around 2014/15. The transport mode will vary and will be either by sea or by rail depending on the type of material being transported. The

⁵ <http://www.nda.gov.uk/documents/upload/Exotic-Fuels-and-Nuclear-Materials-Dounreay-Stakeholder-comments-in-response-to-Credible-Options-May-2012.pdf>



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modes to be used have been chosen based on advice from the Office for Nuclear Regulation as to which mode is most appropriate based on consideration of safety and security.

2.4 Preferred Option

Since completing the credible options paper the NDA has taken into consideration the views of stakeholders and regulators in reviewing the credible options.

The NDA notes the concerns expressed by a number of stakeholders around the transport of nuclear materials and has taken specific advice on the matter from regulators regarding both the security of storage and transport of these materials. Consequently any movements will take place in accordance with that advice.

On balance, taking all factors, including stakeholder views, into account the NDA believes, for the following reasons, that the option for this material which best meets our objectives, is for it to be transported to Sellafield for long term management:

- (a) from a security perspective it allows UK resources to be prioritised in one location
- (b) the quantity of material to be moved is relatively small compared to the inventory currently at Sellafield and therefore the impact of the material is small when compared to the operations to manage the material already there
- (c) transporting the material to, and storing the material at, Sellafield means it is better placed with respect to any future treatment and allows it to be co-managed with other very similar materials
- (d) movements of nuclear material are subject to stringent regulations and can only take place if in compliance with all applicable legislation
- (e) as the contract to deliver the Interim End State⁶ (IES) at Dounreay is progressed over the next 10+ years the challenge of attracting people with the required skills to Dounreay is likely to increase. Storing the material at Sellafield ensures that the skills required to manage the material will be available when they are required
- (f) moving the higher security classification material from the Dounreay site allows the security requirements at the Interim End State to be reduced as well as reducing the cost of security for the site.

⁶ The IES is the point where all waste and any remaining fuels are packaged for long term storage at Dounreay and all other facilities decommissioned.

3 Summary and Conclusions

There are many different forms of exotic fuels and nuclear materials currently safely and securely stored on the Dounreay site, some of which require enhanced site security arrangements.

Having previously published the high level management options associated with the exotics, and having further considered the credible options, we now conclude that the preferred option is for the exotic material to be transferred to Sellafield for long term management.

4 Next steps

The Site Licence Companies at Dounreay and Sellafield will now prepare a Final Business Case and submit this to the NDA Executive around the end of the financial year 2012/13 to enable final approvals of the implementation plans to be take place. The options analysis in Appendix 3 shows the fallback in the event that unforeseen issues arise in implementing our preferred option.

Assuming that the business case is approved by the NDA Executive movement of exotic material would commence around the end of 2014/15. The work required to implement this strategy such as the normal safety case and planning approvals will be executed by Sellafield and Dounreay.

In accordance with our Strategy, the NDA will continue to undertake programmes of stakeholder engagement, as appropriate, as the preferred option for the Dounreay exotics is implemented.

Appendix 1 : Description of exotic groups at Dounreay

Group 1: Unirradiated plutonium bearing fuels

There are approximately 13 tonnes of group 1 material, containing around 2 tonnes of plutonium. It is stored in several locations around the site, and is in the form of powders, metal coupons, pellets and pins. The vast majority of this material is unsuitable for either continued long term storage at Dounreay or for off-site transportation without some form of pre-treatment. The Dounreay Lifetime Plan (LTP) has provision for the installation of an Unirradiated Fuels Conditioning Facility (UFCF) which would provide such pre-treatment.

Group 2: Unirradiated high enriched uranium fuels

There is approximately 1 tonne of group 2 material stored on the site, in the form of oxide powders and pellets, and also some uranium metal and alloys. It is stored individually in several locations in small quantities and would benefit from consolidation into larger, more robust containers suitable for long term storage.

The unirradiated high enriched uranium has a wide range of enrichment values, presenting operational and disposability difficulties.

Group 3: Irradiated fuels

There is approximately 12 tonnes of this material, and the spent Prototype Fast Reactor (PFR) fuel (which is the vast majority of this material) has achieved very high burn-ups which means it requires special handling and transportation arrangements. It is currently safely and securely stored on the Dounreay site.

Appendix 2 : Definitions of option Categories

Term	Definition
Credible option	An option which could be delivered to meet the key objectives as defined.
Preferred option	An options which could be delivered to meet the key objectives as defined and is assessed to offer the best option for delivery.
Contingent option	An option which warrants further development in case the credible options turn out to be undeliverable.
Dormant option	Dormant options represent potential options but which do not need further development at this time.
Rejected option	Rejected options will not be developed further.

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Appendix 3: Update to the Options Analysis since the Publication of the Credible Options Paper

Group 1: Unirradiated plutonium bearing fuels

Option	Status In Credible Option Paper	Updated Status	Rationale for Change
1. Leave material at Dounreay, process for long term storage and store prior to decision on final disposition route.	Credible	Contingent	Leaving material at Dounreay does not reduce the hazard profile of the site or realise the opportunity to make security cost savings at Dounreay. In the event that the final business case identifies any issue that prevents material being sent to Sellafield retaining at Dounreay would be the contingency.
2. Condition material at Dounreay for long term storage and then transfer to Sellafield and store in appropriate storage facilities (such as the Sellafield Product and Residues Store, SPRS), prior to decision on final disposition route.	Credible	Preferred (Selected Option)	Transferring material to Sellafield co-locates similar material in the same place where it can be managed on a long term basis realising economies of scale. Much of the inventory will require conditioning prior to transport in order to make the transport safety case.
3. Transfer material to Sellafield, condition for long term storage, and then store in SPRS, prior to decision on final disposition route.	Contingent	Rejected	Transferring material to Sellafield co-locates similar material in the same place where it can be managed on a long term basis realising economies of scale. Much of the inventory will require conditioning prior to transport in order to make the transport safety case and so conditioning steps at Dounreay will be necessary for much of the inventory.
4. Send material overseas for reprocessing and utilise products.	Contingent	Contingent	There is a low probability that this option could be exercised for a subset of the inventory.

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Group 2: Unirradiated high enriched uranium fuels

Option	Status In Credible Option Paper	Updated Status	Rationale
1. Leave material at Dounreay, process for long term storage and store prior to decision on final disposition route.	Credible	Contingent	Leaving material at Dounreay does not reduce the hazard profile of the site or realise the opportunity to make security cost savings at Dounreay In the event that the final business case identifies any issue that prevents material being sent to Sellafield retaining at Dounreay would be the contingency.
2. Condition material at Dounreay for long term storage and then transfer to Sellafield and store in appropriate storage facilities (such as the Sellafield Product and Residues Store, SPRS), prior to decision on final disposition route.	Credible	Preferred (Selected Option)	Transferring material to Sellafield co-locates similar material in the same place where it can be managed on a long term basis realising economies of scale. Much of the inventory will require conditioning prior to transport in order to make the transport safety case.
3. Transfer material to Sellafield, condition for long term storage, and then store in SPRS, prior to decision on final disposition route.	Contingent	Rejected	Transferring material to Sellafield co-locates similar material in the same place where it can be managed on a long term basis realising economies of scale. Much of the inventory will require conditioning prior to transport in order to make the transport safety case and so conditioning steps at Dounreay will be necessary for much of the inventory.
4. Send material overseas for reprocessing and utilise products.	Dormant	Contingent	There is a low probability that this option could be exercised for a subset of the inventory. If route were to be available for the enriched uranium product it could provide advantages as Sellafield does not currently store bulk highly enriched uranium.

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Group 3: Irradiated Fuels

Option	Status In Credible Option Paper	Updated Status	Rationale
1. Leave material at Dounreay, and store prior to immobilisation at Dounreay and eventual disposal.	Credible	Contingent	Leaving material at Dounreay does not reduce the hazard profile of the site or realise the opportunity to make security cost savings at Dounreay In the event that the final business case identifies any issue that prevents material being sent to Sellafield retaining at Dounreay would be provide the contingency.
2. Transfer to existing facilities at Sellafield and store in Irradiated Fuel Containers within sealed, dry cans, prior to immobilisation or reprocessing.	Credible	Preferred	Transferring material to Sellafield co-locates similar material in the same place where it can be managed on a long term basis realising economies of scale. Much of the inventory will require conditioning prior to transport in order to make the transport safety case.
3. Dry storage in casks at Dounreay prior to transfer to Sellafield for immobilisation or reprocessing.	Rejected	Rejected	No change since credible options paper.
4. Transfer to Sellafield and dry store in dry storage casks prior to immobilization or reprocessing with other similar materials.	Contingent	Contingent	In the event that the final business case identifies any issue with the transport of fuel in irradiated fuel containers, transfer in casks provides a contingency.
5. Reprocess overseas	Dormant	Contingent	A potential new route for this material has recently been identified. The feasibility of the route is still being established and will be considered as a contingency in the event that it is proved to be viable.