



Plutonium Strategy

Current Position Paper

February 2011



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1 Introduction

This document summarises NDA's current position regarding the strategy for managing the existing stocks of UK-owned civil separated plutonium and the future arisings resulting from the completion of the Sellafield reprocessing programme¹. Included within this inventory is the material owned by the Nuclear Decommissioning Authority (NDA) and British Energy (a part of EdF Energy). It is recognised however, that the inventory may change if, for example, British Energy choose a different route for their material or if Ministry of Defence (MOD) owned material became part of the inventory.

The current default position is to treat plutonium as a zero value asset² and store it until 2075 at Dounreay and 2120 at Sellafield after which time the end-state for plutonium is not defined. In 2009 NDA published its first Credible Options paper and since then has continued to support Government in developing its options. This document is published alongside a public consultation dated 7th February 2011 on the long term management of the UK's civil plutonium stocks and an update of the NDA Credible Options paper. NDA will continue working with Government to define and evaluate alternative options which will ultimately result in the development of a strategy to manage the plutonium throughout its full lifecycle.

The main drivers for developing the strategy are:

- To support Government in its policy development activities.
- To present strategic options with a defined end-point, in order for NDA to meet its obligations under the Energy Act.
- To consider the views of organizations, such as the Royal Society, to implement a strategy to manage the UK stockpile to an end point, in the context of international stockpile reduction programmes.
- To provide assurance that the design of any future disposal facilities will accommodate the plutonium if required.
- To enable Site Licence Companies (SLCs) to prioritise effectively in full knowledge of the scope to be delivered both in terms of plutonium directly and the infrastructure required to support plutonium storage and processing.
- To highlight that plutonium bearing materials evolve over time and are likely to become more problematic, and therefore expensive, to manage and the need for this to be factored into timescales for decision making.

¹ As defined in Lifetime Plan (LTP) 10

² The concept of a zero value asset means that there are no cost or revenues attributed to the balance sheet, either from immobilisation or from any revenue that may be generated by recycle options



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- To produce a baseline against which other strategies can be assessed. For example, the future of commercial operations on the Sellafield site.

In summary:

- The strategy development has completed Stage A of the Strategy Management System (SMS) where credible options have now been defined.
- Work is progressing to further refine underpinning data to support the development of Government Policy on the future management of UK plutonium.

Signed:.....Dr Paul Gilchrist..... Date:...04.02.11.....

2 Current Baseline Plan

In the absence of a defined strategy the current Site Licence Company (SLC) baselines treat plutonium as a zero value asset which is planned to be stored for an indefinite period. As yet no ultimate disposition route has been fully developed. The material is currently stored at two locations, Dounreay and Sellafield. Both sites have defined end-points and so their plans only progress as long as activity is maintained on the sites. The Dounreay plan shows the material being stored until 2075. The Sellafield plan shows material being stored until the site end-point in 2120, with the assumption that the material will remain in place beyond that date. After those dates no provisions are included in the plans for the subsequent management of the material.

Issues with the current position:

- The current SLC plans assume continued long term storage but no costs or infrastructure is provided beyond 2075 for Dounreay or 2120 for Sellafield.
- The management arrangements for the long term storage of material at Sellafield and Dounreay are not consider optimised, with co-location of plutonium proposed in the NDA draft strategy³.
- The requirements for the support facilities to ensure the long term safe and secure storage of plutonium are not fully developed.
- The final treatment and disposition route and resulting cost provision requires definition and inclusion in the lifetime plans for Sellafield and Dounreay, so that the NDA can meet its obligations under the Energy Act.

3 Credible Strategic Options

Since the current strategy does not cover the full lifecycle of the material, a number of alternative options have been explored. A more detailed description of the options under assessment has been provided in the "NDA Plutonium Credible Options" paper⁴, which was issued for comment during Summer 2008, published in January 2009 and has been revised, updated and published in February 2011. The credible options paper has been used to support the Government policy development.

³ NDA Draft Strategy II (2010). <http://www.nda.gov.uk/documents/upload/Draft-Strategy-published-September-2010-for-consultation-full-colour-version.pdf>

⁴ <http://www.nda.gov.uk/strategy/nuclearmaterials/plutonium/documentation.cfm>

At a high level the options can very broadly be described as:

- Continued long term storage (prior to disposal)
- Reuse as fuel followed by disposal
- Prompt Immobilisation and disposal as soon as practicable (subject to technical and financial constraints).

3.1 Continued Long Term Storage

The current default position is continued long term storage after which time no final plans are developed. Regardless of what alternative strategies are pursued (either via reuse or directly) it is estimated that the execution of any proposed active strategy would take 30 – 50 years. As such we consider that long term storage remains a technically viable option and is required in all cases while alternative strategies are developed.

However, given that the lifetime plan for Sellafield (the last remaining UK civil nuclear site according to current plans) ends in 2120, it is proposed that the end of storage should be assumed to be 2120, with disposal activities provided to allow this end date to be met.

Factors which might affect this contingency option are:

- Changes to the planned end date for Sellafield.
- Changes to the security regime and security policy in the UK.
- Changes to Government Policy with regard to storage and management of special nuclear materials.

3.2 Reuse

The reuse option is considered as a route for converting plutonium into a disposable form, *i.e.* as spent fuel whilst gaining benefit in terms of energy.

Progressing the reuse option would require extensive supply chain engagement to take place, and ultimately, a procurement exercise would be undertaken. Any decision to reuse the material is a policy matter and would ultimately be made by the Government and in this respect there are a number of implementation options available depending on where Government enters the plutonium value chain.

For the purposes of strategic option analysis, the NDA has examined the options of selling plutonium, or fabricating MOX and selling or leasing the resulting fuel for irradiation in the latest generation (known as third generation, GEN III) of nuclear reactor systems (such as EPR ,AP1000 and CANDU) in either the UK, Europe or Canada.

The option of utilising fourth generation reactor types (GEN IV), such as fast reactors, has been screened out as not credible at this time. There are no GEN IV reactor systems commercially available and it is not considered that they will be commercially available for several decades. Even though the technology for fast reactors is well developed at the research reactor scale, the supply chain has yet to give indication of any substantive commercial development of these systems in the short to medium term.

The NDA has also not considered alternative reactor systems such as High Temperature Reactors (HTRs) and thorium fuelled reactors.

Factors which may influence the reuse option:

- The demand for MOX fuel influencing the revenue that could be received from this option
- The appetite of utilities for using MOX fuel and licensing of UK and overseas reactors to burn Mixed Oxide Fuel (MOX)
- The disposability of spent MOX within the disposal facility concepts.

3.3 Disposal

As long term storage concludes with disposal, this option is defined as prompt disposal, at the earliest opportunity, whilst recognising the financial and technical constraints and lead times for implementation.

It is assumed that the current Geological Disposal Facility (GDF) design concepts would be utilised to accomplish the disposal and the GDF needs to be designed to accommodate this material, noting that the UK owned inventory was included in the MRWS inventory and the generic Disposal System Safety Case. There are technical and public acceptability risks in this assumption which may ultimately lead to alternative approaches having to be developed and this is one of the key reasons for maintaining the long term storage option.

A number of disposal technologies have been considered. Work to date has focussed on disposal

- as glass via vitrification
- as a ceramic in either low specification MOX or by using the Hot Isostatic Press process, or
- immobilisation in cement based grouts.

Factors that may influence this option:

- Public acceptability.
- The development of disposable packages.

- Changes to assumed security regimes around a disposal facility.
- The disposal facility concept.
- The ability to implement the technology on a suitably large scale. .

4 Topic Strategy Objectives and Future Scope

The objective of the strategy is to ensure the safe management then ultimate disposition of UK owned plutonium.

4.1 Future planned work

4.1.1 Development of GDF Concepts

The disposal facility concepts are being reviewed against the requirement to dispose of around 100te of plutonium. This work addresses issues such as waste durability, repository safety-case issues and concepts of co-disposability. It will result in the development of Pre-Conceptual Letter of Compliance for each of the waste forms being considered and will narrow the uncertainty associated with different waste forms, acceptable incorporation rates and disposal volumes.

4.1.2 Commercial Approach

NDA will examine possible commercial implementation approaches for the range of credible options to support Government.

4.1.3 Exploration of Policy Framework

NDA will work with Government whilst they develop the policy framework(s) such that coherent decisions for the future management of plutonium can be made.

5 Topic Lifecycle

To support the Government public Consultation on plutonium management issued on the 7th February 2011 and any subsequent implementation, NDA will work with government to establish key activities that need to be undertaken.

In addition, technical work will progress to further refine and underpin the credible options and enable better informed future discussion with stakeholders

6 Key Topic Interfaces

The plutonium strategy has the potential to influence a number of other topic strategies. Some of these interactions are at a fundamental level, termed primary interactions. Others have a secondary effect resulting either from certain options being chosen or from the introduction of additional scope into LTPs.



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6.1 Primary Interfaces

Spent Fuel Theme (comprising metal, oxide and exotic topic strategies): The Spent Fuel Strategy is being developed in parallel, and the interaction will be managed through communication between the relevant NDA Strategic Authorities for each strategy.

Higher Activity Wastes: There is a strong interaction with the planned Geological Disposal Facility (GDF). The uncertainties around the disposal concept and the disposability of the different waste forms are key aspects to making decisions around Pu. Consequently the work needed to address these issues is being undertaken by Radioactive Waste Management Directorate (RWMD) and addressing these issues are being incorporated into the strategy development. Development of the GDF concept is taking place in parallel to the Plutonium Strategy development project.

Revenue and Asset Optimisation: As a result of decisions being taken with respect to the UK owned materials, there may be impacts for commercial operations on the Sellafield site. Commercial strategies are being constantly reviewed in terms of the future availability of NDA assets for commercial operations or utilisation of existing assets for UK disposition activities. The relevant NDA Strategic Authorities are engaged to ensure that the impact of one on the other are understood.

6.2 Secondary Interactions and Opportunities

Decommissioning and Clean-up: Additional facilities are likely to be required as a result of the delivery of the current strategy. Although the result may be an increase in scope it is not considered likely that a change in overall site strategies will be required.

Uranium and High Activity Waste: Some of the options under consideration may offer opportunities in terms of co-disposal with other wastes or uranium. Examples of this could be to use depleted uranium in fabricating low specification MOX or the co-disposal of plutonium in ILW waste forms as part of the encapsulation in cement. These concepts are currently being explored further to determine whether there is benefit in pursuing these approaches.

Funding: Implementation of any revised strategy would result in increased costs above and beyond those which are currently in the baseline. Ultimately the timing of any implementation will be determined with Government.

Skills: Execution of these strategies will require people with a plutonium skill base. The timing of the execution needs to be considered with a view to having key skills available when they are required. In order for the skills base to be maintained, such that at least train the trainer type skills are available into the future, thought needs to be given to skills retention. This should be a consideration in the funding of future work programmes.

7 Site Interfaces

Plutonium is currently stored on the Sellafield and Dounreay sites.

8 Key Policy Issues

The development of proposals for plutonium management is being progressed by DECC with the launch of a public Consultation on the 7th February 2011.

Prior to this, DECC have published, on their website⁵, background policy information on plutonium management, which provides a summary of the International guidelines for the management of civil plutonium. They also held a Workshop in May 2009 on the long term management of the UK's separated civil plutonium in Manchester, and summary report⁶ and transcript report⁷ are also available on the DECC website.

DECC also prepared two pre-consultation discussion papers for comment. The first considers the factors which could be important when judging one potential option for long term plutonium management against another. The second considers the decision-making methodology and issues around when is the right time to make a decision on selecting a preferred option. These pre-consultations have formed the basis of the full public consultation.

9 Regulatory Interfaces

Regular meetings have been held with the regulatory Strategic Authorities for nuclear materials as the credible options have been developed.

The regulators have provided advice into the process, but a formal regulatory approval has not been sought. In their advisory capacity the regulators have raised a number of issues and these are in the process of being addressed. These include items such as the need to:

- identify the drivers for the strategy change
- address storage as an option
- identify contingency strategies
- reflect the precautionary principle and ALARP in the development of strategies
- maintain an audit trail that shows how options have been identified and where appropriate excluded

⁵http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/issues/plutonium/plutonium.aspx

⁶http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/nuclear/plutoniummanagement/1_20090902103846_e_@@_plutoniummgmtworkshopsummary.pdf

⁷http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/nuclear/plutoniummanagement/1_20090902103905_e_@@_plutoniummgmtworkshoptranscript.pdf

- bring out any assumptions that have been made with regard to policy and the need to reflect future skills requirements.

The NDA accepted the advice that has been given in developing the credible options.

10 Environmental Issues

The current environmental assessment of options has focussed on the carbon dioxide and radiological discharges from different strategies. It is recognised that in many cases, for the current level of development of the plans these metrics do not discriminate between options and further work needs to be undertaken, as part of the SMS, in conjunction with the environmental regulators to define suitable methodologies.

As the Policy and strategy development proceeds an Strategic Environmental Assessment (SEA) for the plutonium management may be required and as such would be completed for the options under consideration.

11 Stakeholder Engagement

Earlier engagement on the credible options has taken place *via* the 'NDA Plutonium Options' comment paper which was published on the NDA website in the summer of 2008. Stakeholder comments were incorporated into the credible options paper, published in January 2009. Workshops were held in October and November 2008 to feedback the advice and comments received from stakeholders and to start to plan the next phase of engagement. In addition, a number of one-to-one briefings were held with organisations who expressed an interest in hearing more about the plans for the plutonium strategy.

The next phases of engagement will be developed once Government has completed their public consultation on the development of proposals for plutonium management. NDA will support Government, as required, both during the Consultation period and thereafter.

12 Governance Arrangements

In general key deliverables will be endorsed by the Strategic Authority Forum (SAF). The Spent Fuel and Nuclear Materials Theme Overview Group (TOG) and the Strategy Development and Delivery Group (SDDG) or equivalent will provide Government and Regulatory input during the strategy development stages⁸. Approval of key deliverables will be sought from the NDA Executive and, if necessary, the NDA Board. Final endorsement from Government will be sought where this is required.

⁸ The Strategic Authority Forum is an NDA peer working group, the TOG is comprised of NDA, Government and Regulatory strategic authorities, and the SDDG is a Governmental and Senior Regulatory strategy advisory group



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Interim deliverables will be endorsed by the SAF and TOG. Where there are deliverables that impact on the SLCs, the Site Strategic Committees will also be asked to provide endorsement.