

DOUNREAY RADIOACTIVE WASTE SUBSTITUTION CONSULTATION 2010



The Scottish
Government

DOUNREAY RADIOACTIVE WASTE SUBSTITUTION

Consultation on a Policy for Substituting Overseas
Radioactive Wastes at Dounreay

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Executive Summary

The Scottish and UK Governments are consulting on a proposed policy of radioactive waste substitution for the radioactive waste arising from historic fuel reprocessing contracts with overseas customers at Dounreay. In this document the use of “Government” refers collectively to the Scottish and UK Governments where policy and responsibilities are aligned. Where policies and responsibilities differ, separate references are made to either the Scottish or the UK Government.

Radioactive waste substitution means that, instead of returning customers the radioactive waste allocated to them under their reprocessing contracts, a radiologically equivalent amount of radioactive waste from a different waste stream will be returned instead. This radioactive waste could be from another facility within the Nuclear Decommissioning Authority’s (NDA’s) estate.

The NDA now owns Dounreay and it is operated under contract by Dounreay Site Restoration Limited (DSRL). Between 1959 – 1994 Dounreay was at the forefront of the UK’s research into fast reactor technology and it:

- manufactured fuel
- operated three reactors
- reprocessed the spent fuel from the three reactors.
- entered into a number of agreements with overseas research reactor operators to reprocess their spent fuels at Dounreay which require the recovered nuclear materials and allocated radioactive wastes to be returned.

The decision to stop fast reactor research at Dounreay in the mid 1990s and reprocessing in 2001 changed the focus of the site from operational to decommissioning activities. Over time, the radioactive waste management strategy has been adjusted to align with the focus on decommissioning. Dounreay’s high level radioactive waste (HLW) had sufficiently radioactively decayed to be reclassified as intermediate level radioactive waste (ILW) in the 2004 UK Radioactive Waste Inventory. As a result, Dounreay no longer needs a vitrification plant for its own wastes as was originally envisaged. It would not be economically viable to construct, run and decommission a vitrification plant at Dounreay for the small amount of radioactive waste from overseas customers. Such a plant is estimated to cost in the order of several hundreds of millions of pounds.

The Nuclear Decommissioning Authority (NDA) is responsible for the contracts with the overseas customers and has sought clarification from Government about using radioactive waste substitution arrangements to enable the return of radioactive wastes to overseas customers on the earliest possible timescale in forms that they are able to accept. This will help support the Dounreay site radioactive waste management strategy.

The principle of radioactive waste substitution has already been accepted in the UK and there are policies for low level radioactive Waste (LLW) and ILW substitution covering overseas reprocessing contracts at Sellafield. However, there is currently no comparable policy for Dounreay contracts.

Chapters 1 – 3 of this consultation document explain:

- Why a radioactive waste substitution policy is being consulted on
- Dounreay's historic contracts, the radioactive wastes created and their management
- The implications of the policy for the NDA, Dounreay and the UK as a whole

Chapter 4 contains the proposed policy statement allowing the substitution of:

- Prototype Fast Reactor (PFR) and Cemented Materials Test Reactor (MTR) raffinate wastes from Dounreay with vitrified radioactive wastes from Sellafield and,
- PFR raffinate waste with Cemented MTR raffinate waste for overseas customers who may still wish to receive their radioactive waste in cemented form.

A number of questions are asked of Consultees in chapter 5.

For further information on radioactive waste including the legislative framework, please refer to the Supplementary Guidance for Higher Activity Radioactive Waste (HAW) at:

<http://www.scotland.gov.uk/HAW-Sup>

Guidance for Consultees

The Scottish Government and the Department of Energy and Climate Change are inviting written (by post or email) responses to this consultation by **Friday 11 March 2011.**

Please send your response, including the **Respondent Information Form** to:

radioactivewasteteam@scotland.gsi.gov.uk

Or:

Dounreay Radioactive Waste Substitution Consultation
Scottish Government
The Rural and Environment Directorate
Environmental Quality Division
Area 1-H North
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EH6 6QQ

If you have any queries about this consultation, please contact us on the email address above or on 0131 244 0199.

Please indicate in your response which questions or part of the Consultation Document you are responding to as this will aid our analysis of the responses received.

The Consultation Document can be found at:

<http://www.scotland.gov.uk/Dounreay-Waste>

1. Why We Are Consulting

Introduction

This Chapter outlines:

- why a policy for radioactive waste substitution is needed for Dounreay
- why we are not undertaking a Strategic Environmental Assessment
- the current radioactive waste substitution policies in the United Kingdom
- the proposed policy
- the reasons for this proposal, including the implications of the customers' current radioactive waste facilities

1.1 Why a Policy for Radioactive Waste Substitution is Needed for Dounreay

1.1.1 The Nuclear Decommissioning Authority (NDA) has sought clarification from Government about using radioactive waste substitution arrangements for the return of radioactive wastes resulting from reprocessing of overseas research reactor fuel at Dounreay. That is, instead of sending customers the radioactive waste allocated to them under their reprocessing contracts, an equivalent amount of radioactive waste from another source within the NDA's estate would be sent. Further information on the NDA can be found at:

<http://www.NDA.gov.uk>

1.1.2 More specifically, approval has been requested for the substitution of:

- Prototype Fast Reactor (PFR) and Cemented Materials Test Reactor (MTR) raffinate wastes from Dounreay with vitrified radioactive wastes from Sellafield and,
- Prototype Fast Reactor raffinate waste at Dounreay with Cemented Materials Test Reactor raffinate waste at Dounreay

1.1.3 The NDA owns the UK's legacy civil nuclear facilities and is responsible for their decommissioning and clean up. In the case of Dounreay it has also inherited the long standing contracts for reprocessing of overseas research reactor fuel and the subsequent

return of radioactive wastes. Requests from these overseas customers for radioactive wastes to be returned in forms that they are able to manage, along with the need to clarify the Dounreay site radioactive waste management strategy, have led the NDA to approach Government with a request to fulfil contractual obligations with radioactive wastes that are already available within its overall estate. In other words NDA has asked Government if it can implement radioactive waste substitution to return these wastes.

1.1.4 Clarity about the Government's policy on radioactive waste substitution is therefore necessary to allow the NDA to complete the discussions with its overseas customers.

1.2 Strategic Environmental Assessment

1.2.1 The proposed policy has had to be considered within the terms of the Environmental Assessment of plans and programmes Regulations 2004 (UK Regulations) as it relates to more than just Scotland. Having considered the matter carefully, it is our view that an Strategic Environmental Assessment (SEA) is not required, as the proposed policy falls outside the coverage of the 2004 Regulations.

1.3 The Current Radioactive Waste Substitution Policies in the United Kingdom

1.3.1 The existing policy on radioactive waste substitution, is limited to the substitution of High Level radioactive Waste (HLW) for Low Level radioactive Waste (LLW) and Intermediate Level radioactive Waste (ILW) arising from overseas reprocessing contracts at Sellafield. The policy covers the radioactive waste arising from the reprocessing of around 4,500 tonnes of nuclear fuel at Sellafield. However that policy does not cover the substitution of any radioactive waste at Dounreay.

1.3.2 The first policy about radioactive waste substitution was stated in 1995 in Cm 2919: Review of Radioactive Waste Management Policy Final Conclusions. Whilst much of Cm 2919 has been superseded, the principle of radioactive waste substitution for Sellafield allowing British Nuclear Fuels Limited (BNFL) to return additional volumes of HLW overseas in place of LLW still stands,¹ although it is now the NDA who is responsible for any reprocessing contracts signed by BNFL.

1.3.3 The policy also covered the substitution of HLW in place of ILW but this was updated and replaced by the December 2004 Intermediate Level Radioactive Waste Substitution policy statement.² This approved the retention and long term management in the UK of overseas ILW under existing BNFL contracts with the return of an additional, radiologically equivalent amount of HLW in its place. Again, it is now the NDA who is responsible for these contracts.

1.3.4 The principle of radioactive waste substitution is therefore already established. The proposed policy would extend this principle to the radioactive waste allocated to customers under their reprocessing contracts at Dounreay. The amount of fuel covered by these contracts is very small in comparison with Sellafield and amounts to approximately two tonnes.

1.4 The Reasons for this Proposal

1.4.1 A radioactive waste substitution policy for Dounreay would bring a number of benefits. These include:

- The ability to return radioactive wastes earlier, in a form that recipient states can accept
- Clarity for Dounreay's future radioactive waste management needs
- Simplification of transport of radioactive waste overseas
- Completion of contracts
- Avoiding the need to construct another vitrification plant

These are described in more detail below.

1.4.2 Current Government Policy is for overseas radioactive waste to be returned as soon as practicable. Allowing the NDA to offer radioactive waste substitution as an option for managing its overseas customers' radioactive wastes at Dounreay would result in radioactive waste being returned overseas sooner than if radioactive waste substitution was not an option.

1.4.3 Agreement with customers on the type of radioactive waste to be repatriated would clarify management arrangements required for decommissioning operations at Dounreay. This in turn would be expected to minimise delays in reaching the Interim End State and therefore reduce overall expenditure.

1.4.4 There is no cementation plant for PFR reprocessing radioactive waste at Dounreay nor is one likely to be available for several years (the plans for the construction of this facility are currently on hold³). This is in contrast to the cementation plant for MTR reprocessing radioactive waste, which is expected to finish immobilising all of the MTR reprocessing radioactive waste by the end of 2013. Where the return of vitrified radioactive waste from Sellafield is not acceptable to customers, enabling a single type of cemented radioactive waste to be returned to these customers would simplify arrangements, allow radioactive waste to be returned as soon as practicable and give Dounreay greater clarity of its future radioactive waste management requirements.

1.4.5 Some of Dounreay's customers do not have facilities for handling the cemented ILW produced at Dounreay or even have plans to develop them. Without a radioactive waste substitution option available, this radioactive waste would most likely have to remain in the UK until an overseas facility was ready to receive it. On the other hand, in many countries facilities for vitrified radioactive waste or plans for them are further advanced. Given that the contracts between the NDA and these overseas customers do not allow radioactive waste to be returned prior to the customers being ready to receive it in a form that they can handle, it is likely that it will be possible to return vitrified radioactive wastes well in advance of some cemented radioactive wastes.

1.4.6 Sellafield already has arrangements in place for transporting vitrified radioactive wastes to overseas customers. Subject to appropriate commercial terms, it may be possible to incorporate the radioactive waste return obligations from Dounreay within these arrangements. Limited arrangements are in place for the return of MTR radioactive wastes from Dounreay. However, there are no arrangements in place for the return of PFR radioactive wastes from Dounreay and these could not fully be put in place until 2017 at the earliest.

1.4.7 In the event that sending vitrified radioactive waste from Sellafield was not an option but the NDA's customers were asking for vitrified radioactive waste, having to design, build, operate and eventually decommission a vitrification facility at Dounreay to satisfy these contracts would represent a significant cost to the UK taxpayer. While the exact cost of a vitrification plant for Dounreay has not been determined, it is estimated to be in the order of several hundreds of millions of pounds. It is also worth noting that this facility would itself become contaminated through the treatment of radioactive waste, thereby creating more radioactive waste when it is decommissioned. A further facility would

have to be constructed at Dounreay to allow export of the vitrified radioactive waste directly to sea transport. Alternatively, all vitrified radioactive waste produced at Dounreay would have to be transported overland to the existing Residue Export Facility in West Cumbria. There is no technical necessity for any of this plant at Dounreay, it would be solely used for the treatment of this relatively small amount of overseas radioactive waste. Government does not believe such plant is justifiable for the very small quantities of radioactive waste involved, especially as a vitrification plant is already in operation at Sellafield.

1.5 Summary

1.5.1 The ability to return vitrified radioactive waste from Sellafield in place of radioactive waste from Dounreay and/or returning cemented MTR radioactive waste in the place of PFR radioactive waste makes best use of the facilities that already exist and brings several benefits, including increased certainty on the overall decommissioning program for Dounreay. Government therefore proposes extending existing radioactive waste substitution policy to cover radioactive wastes at Dounreay from overseas contracts.

2. Dounreay's Historic Contracts & the Current Situation

Introduction

This chapter outlines:

- the background to the NDA's commercial contracts which would be affected by a Dounreay radioactive waste substitution policy
- the nature of the radioactive waste
- the effect of the decision to cease research and reprocessing at Dounreay

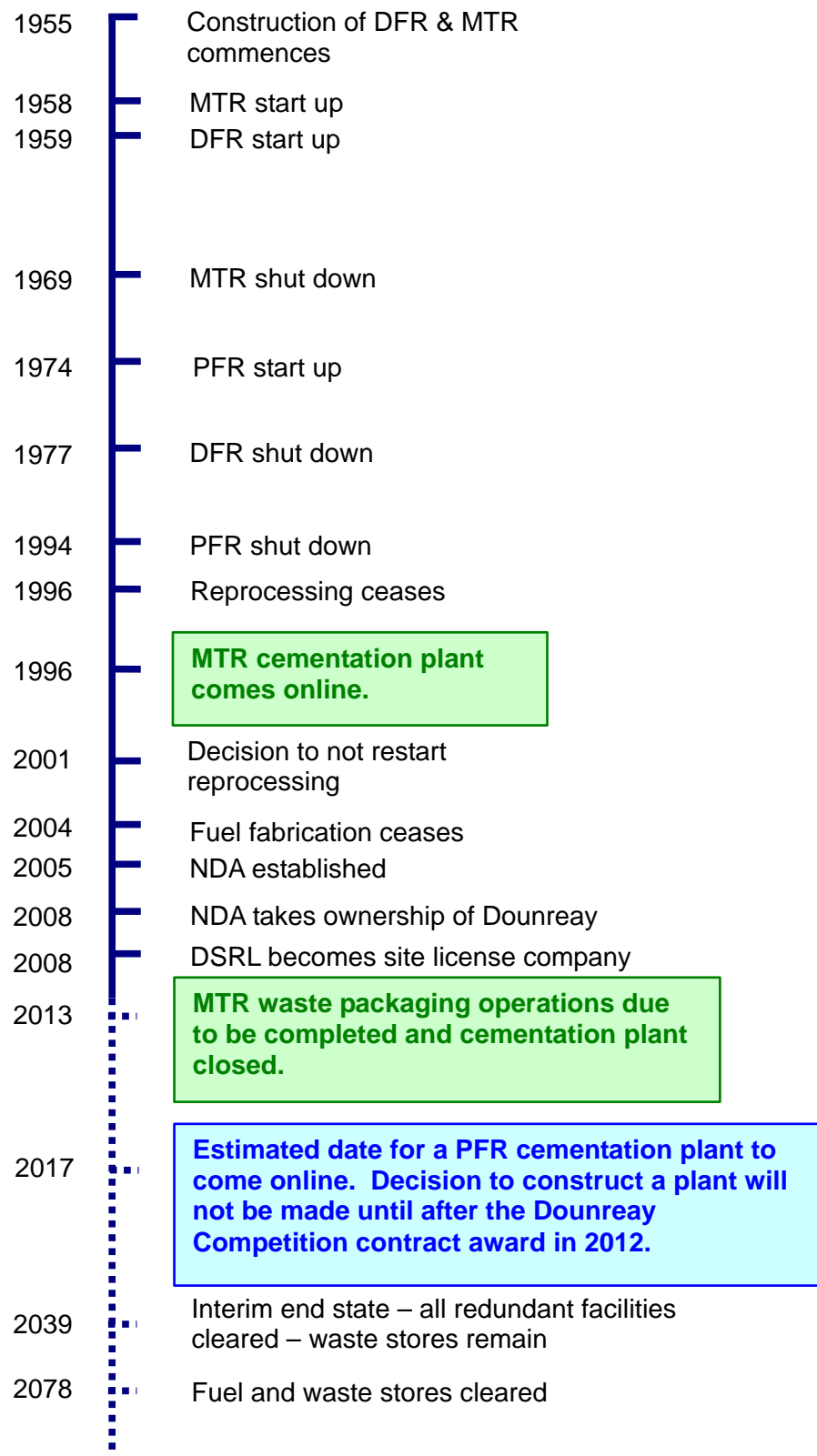
2.1 Background to the Commercial Contracts at Dounreay

2.1.1 Dounreay was the UK's research and development establishment for fast nuclear reactor technology for nearly 50 years. There were three reactors: the Materials Test Reactor (MTR), the Dounreay Fast Reactor (DFR) and the Prototype Fast Reactor (PFR). These reactors operated at different periods, spanning from 1958 until 1994. A timeline showing key dates in the history of Dounreay can be found in Figure 1. Spent nuclear fuel was generated as a result of the operation of these reactors. Each reactor had its own dedicated reprocessing plant which recovered the unused, reusable nuclear materials e.g. uranium, plutonium. Reprocessing also produced a radioactive liquid waste called 'raffinate' for which there is no further use.

2.1.2 From the mid 1950's through to 2008, the United Kingdom Atomic Energy Authority (UKAEA) was the UK Government non departmental public body responsible for operating Dounreay.

2.1.3 UKAEA entered into a number of commercial contracts with overseas research reactor facilities to reprocess their fuels through the MTR and PFR reprocessing plants at Dounreay. The typical quantities of overseas fuel delivered were small, totalling approximately two tonnes. Based on current assumptions for allocation of radioactive waste under Dounreay reprocessing contracts, a further 175m³ of ILW could be retained in the UK as a result of implementation of vitrified waste substitution arrangements. This represents an increase of only 0.07% on the stocks of UK owned ILW.

2.1.4 The ownership of Dounreay transferred from UKAEA to the Nuclear Decommissioning Authority (NDA) in April 2008. The site is currently operated by 'Dounreay Site Restoration Limited' (DSRL) under contract to the NDA.

Figure 1 - Dounreay Site Timeline⁴

2.1.5 An important consequence of the transfer of UKAEA's assets to the NDA is that UKAEA's commercial contracts with overseas customers were also transferred to the NDA.

2.1.6 The contracts entered into by UKAEA contained clauses allowing for the radioactive waste allocated to overseas customers under the reprocessing contracts to be returned to the country of origin:- the "Return of Waste Clauses". It is Government policy that these clauses be enacted and the radioactive waste sent back to the countries of origin. However to enact these clauses, the NDA is contractually obliged to return the radioactive waste in a form which can be safely transported and stored in accordance with such regulations as may be specified by the relevant competent national authorities.

2.1.7 The countries with radioactive waste at Dounreay which is due to be returned to them are Australia, Belgium, Germany and Italy.

2.2 The Radioactive Waste

2.2.1 Raffinate is a radioactive waste which is removed as liquid during reprocessing of spent fuel. In order to return this raffinate to customers, the liquid radioactive waste needs to be converted into a form that is suitable for transportation, storage and disposal. This process is called immobilisation. To achieve this immobilisation, ILW raffinate which has arisen from the reprocessing of fuel at Dounreay can be mixed with cement. Figure 2 shows a typical drum used to solidify liquid radioactive waste for transport and storage by mixing with cement.

Figure 2 – Diagram of a 500 Litre Stainless Steel Cementation Drum⁵

2.2.2 Reprocessing of fuel at Sellafield has created raffinates that are more radioactive than the raffinates produced at Dounreay and these are classified as HLW. Currently in the UK, HLW is immobilised by a process of vitrification. That is, the raffinate is mixed with molten glass and solidified. The only vitrification facility in the UK is located at Sellafield. Figure 3 shows a vitrification canister used at Sellafield.

Figure 3 – Sellafield Stainless Steel Vitrification Canister⁶

2.2.3 Due to the nature of the fuels and the design of the different reactors, reprocessing MTR fuel generated ILW raffinates, whilst reprocessing of PFR fuel originally generated HLW raffinates. Figure 4 sets out the main steps involved in the reprocessing of MTR spent fuel. It shows where overseas spent fuel was fed into this process and where the cemented radioactive waste is produced. Figure 5 sets out the main steps involved in the reprocessing of PFR spent fuel. It shows where the overseas spent fuel was fed into this process and, importantly, the current status of the raffinate waste encapsulation and drum storage facilities.

2.2.4 Radioactive waste at Dounreay that was previously classified as HLW was reclassified as ILW in the 2004 UK Radioactive Waste Inventory. This happened because it had decayed sufficiently so that it no longer generated enough heat to be classified as HLW.

Figure 4 – MTR fuel reprocessing & waste cementation process

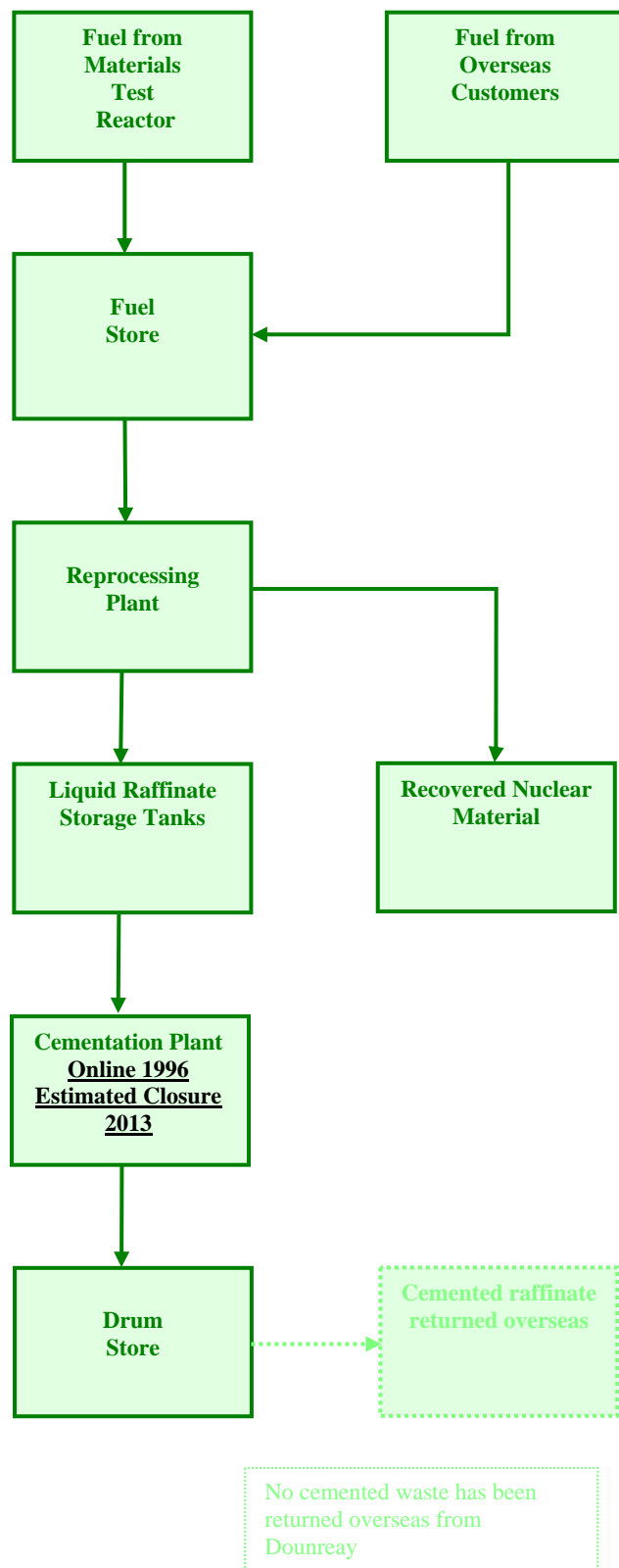


Figure 5 – PFR fuel reprocessing & waste cementation process

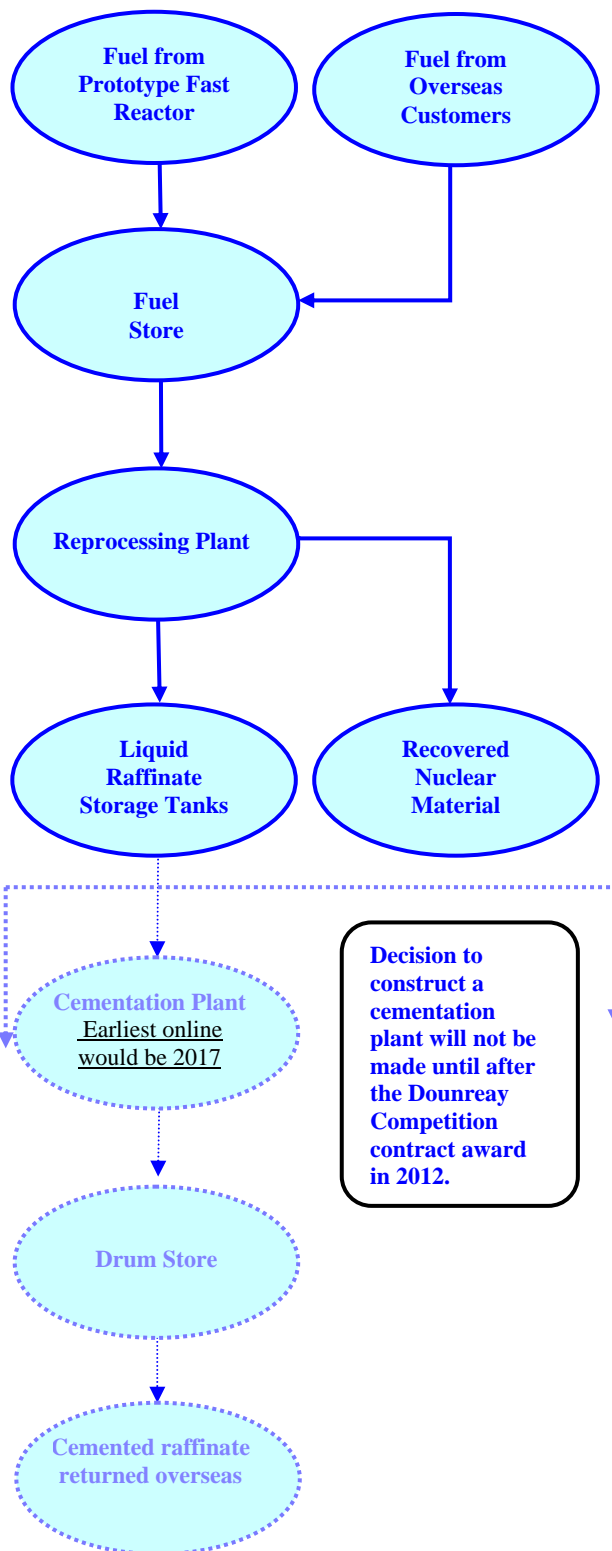


Figure 6 - Dounreay Cementation Plant (Courtesy DSRL)

2.2.5 Capability currently exists at Dounreay to produce transportable radioactive waste from the MTR liquid raffinate in the form of cemented drums. A photo of this facility can be seen in Figure 6. Plans to construct a cementation plant for radioactive waste generated by the PFR reprocessing plant are currently on hold and a plant is not expected to be ready until 2017 at the earliest.⁷ Figure 8 in Appendix B, shows a dummy cemented drum that has been cut open to display the cemented contents.

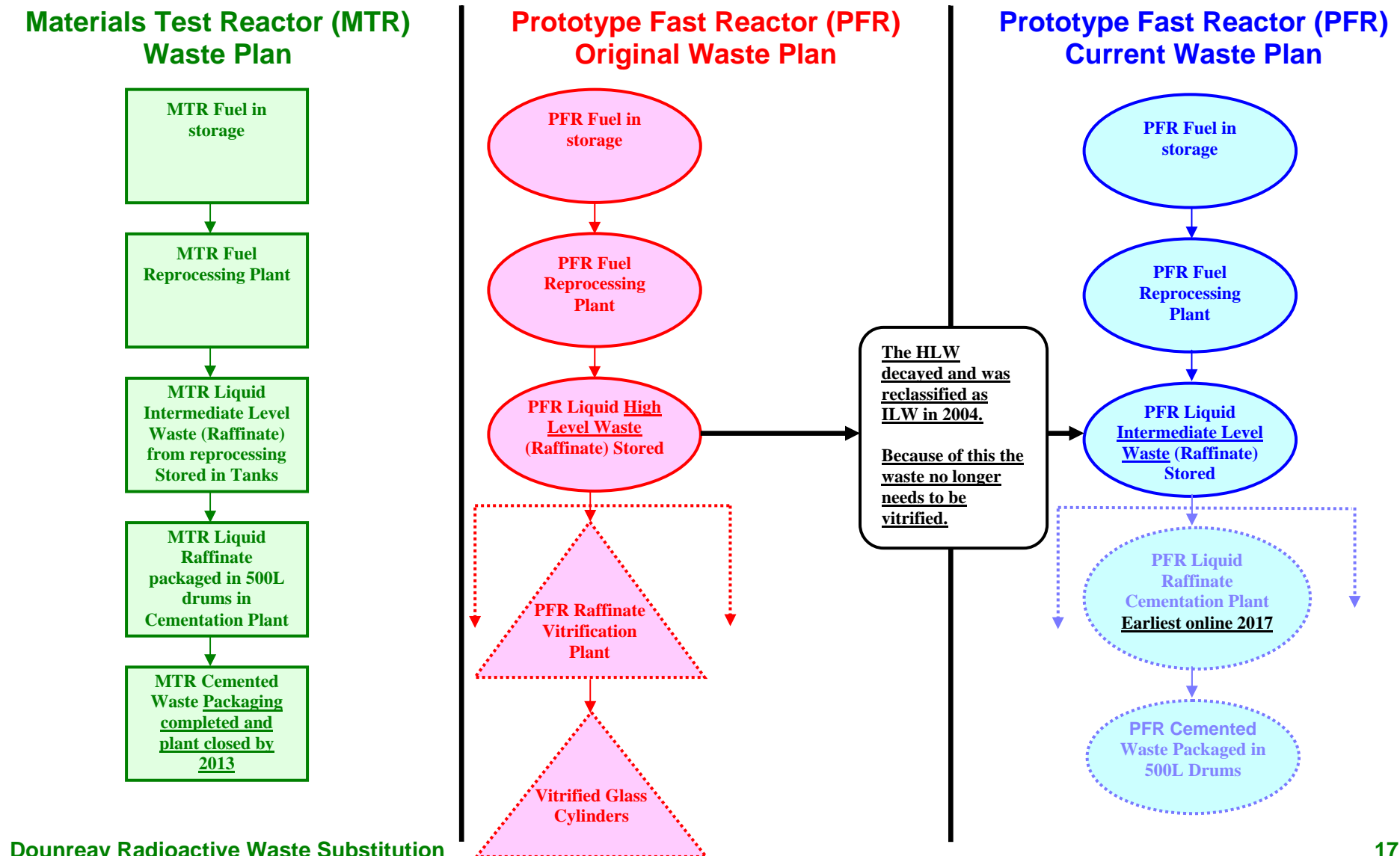
2.3 Why has the treatment of Radioactive Waste at Dounreay Changed?

2.3.1 Work at Dounreay was research-based and there were therefore many uncertainties in the amounts and types of radioactive waste to be produced. Far less radioactive HLW raffinate was produced than had been expected. There are three related key factors which mean that the diversity of radioactive waste produced at Dounreay was never realised.

- The cessation of reactor operations in 1994;
- Cessation of reprocessing in 1996 and decision to not restart reprocessing in 2001; and
- All HLW at Dounreay was reclassified as ILW in the 2004 UK Radioactive Waste Inventory as it had decayed sufficiently that it no longer generated enough heat to be classified as HLW. This reclassification was technically underpinned and supported by a public consultation exercise.⁸

2.3.2 The effect of these three factors has been significant. Whilst both cementation and vitrification are established technologies there are significant differences in their application and cost. There is only one vitrification plant in the UK, used at Sellafield for the encapsulation of liquid HLW arising from reprocessing into a solid glass form encased in stainless steel containers. Cementation on the other hand is widely used throughout the nuclear industry for encapsulation of both LLW and ILW. Dounreay and Sellafield use cementation for encapsulating both liquid and solid ILW and LLW. For some years now Dounreay has been following a cementation strategy for managing its ILW raffinate wastes

Figure 7 – Dounreay Fuel Reprocessing Waste Plans



3. Implications of the Proposed Policy

Introduction

This chapter outlines:

- an overview of the implications
- environmental neutrality
- the implications for Dounreay
- the implications for radioactive waste transportation
- the implications of not implementing the policy

3.1 Overview of the Implications

3.1.1 If the proposed policy is adopted, the NDA will be able to introduce radioactive waste substitution as a viable option in its contractual discussions with overseas customers. As some of the customers have already signalled their intention to seek the return of their radioactive wastes in a vitrified form, there is a high probability that this option would be chosen as a means to finalise the contracts.

3.1.2 There will be different implications for Dounreay, Sellafield and the NDA's overseas customers, depending on whether or not radioactive waste substitution for Dounreay is adopted. The different implications are described in more detail below together with the fundamental principle under which any radioactive waste substitution would take place, which is one of broad environmental neutrality.

3.2 Environmental Neutrality

3.2.1 To ensure that the implementation of a radioactive waste substitution policy would not result in any environmental detriment to the UK, the substitution of radioactive wastes at Dounreay would need to be undertaken on the basis of broad environmental neutrality.

3.2.2 Government proposes that the primary consideration for determining broad environmental neutrality would be that substituted radioactive wastes should be radiologically equivalent. It is proposed that it should be a matter for the NDA, in conjunction with Sellafield Ltd and DSRL, to facilitate the determination of the precise methodology used to calculate this radiological equivalence. However, in the case of substitution of vitrified radioactive waste from Sellafield for Dounreay PFR and MTR radioactive wastes, Government would require that

environmental neutrality be agreed, jointly, by the Scottish Environment Protection Agency (SEPA) and the Environment Agency. For the substitution of cemented MTR radioactive waste for PFR radioactive waste, Government would require that the environmental neutrality is agreed by SEPA.

3.3 Implications for Storage at Dounreay

3.3.1 Until the NDA concludes discussions with all of its overseas customers, it is not possible to specify the final impact that radioactive waste substitution would have on the amount of overseas radioactive waste at Dounreay. However, it is important to note that any radioactive waste remaining at Dounreay would be managed in line with Scottish Government policy on radioactive waste. The overall consequences in terms of the number of drums for the two types of substitution are described below:

- If MTR cemented radioactive waste is substituted for PFR radioactive waste, more drums would be returned overseas and fewer drums of radioactive waste would remain at Dounreay. This is because the concentration of radioactivity in MTR radioactive waste is lower than that in PFR radioactive waste.
- If vitrified radioactive waste at Sellafield is substituted for MTR and/or PFR radioactive waste at Dounreay, less vitrified radioactive waste would remain at Sellafield and more drums of radioactive waste would remain at Dounreay. The concentration of vitrified radioactive waste is higher than that of PFR and MTR radioactive waste.

3.3.2 The amount of cemented radioactive waste arising from reprocessing overseas fuel at Dounreay is very small in relation to the overall amount of cemented radioactive waste that will be stored at the site arising from its own activities. Again at this time it is not known exactly what the impact of radioactive waste substitution would be but, at the very most (where all customers received substituted vitrified radioactive waste), what remained in the UK as a result of this substitution would account for approximately 3% of the total drum inventory at Dounreay and around 0.07% of the UK owned Intermediate Level radioactive Waste. At the other extreme (where all Dounreay's customers choose substituted cemented MTR radioactive waste drums) then there would be an overall reduction in the number of drums remaining on the site, reducing the inventory by less than 1%. Notwithstanding this current uncertainty in the number of drums,

Dounreay's ILW storage facilities are designed to hold 12,000 drums of radioactive waste and therefore any increase in stored drums through radioactive waste substitution can already be accommodated within these existing arrangements.

3.3.3 The storage of raffinate waste is an established practice at Dounreay and is subject to regulatory scrutiny in accordance with health, safety and environmental legislation. Any change in the number of drums stored at Dounreay would be subject to normal regulatory scrutiny.

3.4 Implications for Radioactive Waste Transportation

3.4.1 Until the NDA concludes discussions with its overseas customers, it is not possible to determine the exact number of shipments required to return the radioactive waste to these overseas customers. Arrangements for the transportation of the radioactive waste to the overseas customers would be drawn up if the policy is adopted and Dounreay's customers pursue this substitution option. That said it is possible to give a very high level view of the potential consequences:

- If MTR cemented radioactive waste is substituted for PFR radioactive waste, more shipments may potentially be required because there would be more drums being returned. This is because the concentration of radioactivity in MTR radioactive waste is less than that in PFR radioactive waste. However, it may also be the case that the additional number of drums could be returned in the same number of shipments.
- If vitrified radioactive waste from Sellafield is substituted for cemented radioactive waste at Dounreay, it is possible that fewer shipments of radioactive waste would be required from the UK. This is because the vitrified radioactive waste is much more concentrated than either the PFR or MTR radioactive waste at Dounreay.

3.4.2 Transportation of radioactive materials and radioactive wastes is an established process that is undertaken by International Nuclear Services (INS) and Pacific Nuclear Transport Limited (PNTL) on the behalf of the NDA. Since 1975 over 170 shipments of vitrified radioactive waste, spent fuel, Mixed Oxide Fuel (MOX) and other nuclear materials have been completed safely. These shipments are carried out in full compliance with international laws and regulations. Any shipment of radioactive waste to the overseas customers will be undertaken to

these high standards and this will be the case whether the policy is implemented or not.

3.5 Implications of Not Implementing the Proposed Policy

3.5.1 If the proposed policy is not implemented, the NDA will still be required to return the overseas radioactive wastes from Dounreay. This could be achieved by sending cemented MTR and PFR radioactive wastes, noting that cemented PFR radioactive waste will not be available until at least 2017, or if alternative arrangements cannot be found, by building a vitrification plant at Dounreay and returning vitrified PFR radioactive wastes and cemented MTR radioactive wastes.

3.5.2 Under the assumption that radioactive waste substitution is not an option, overseas MTR radioactive wastes would need to be returned as cemented MTR radioactive waste from Dounreay. This is because nearly all of the MTR radioactive waste has already been cemented. However, many of the overseas customers do not currently have facilities or regulations in place to transport, receive, handle or store cemented radioactive waste. This means that the radioactive waste may need to remain at Dounreay until these facilities are available. The timeline for the construction of facilities is unknown and outside of the direct control of the NDA and Government. This could lead to the storage of the overseas radioactive waste at Dounreay as well as the operation and maintenance of the necessary plant and plant infrastructure required for radioactive waste returns for a prolonged and as yet undetermined period of time.

3.5.3 The argument above applies equally to overseas PFR radioactive waste. Furthermore, given a cementation facility for the PFR radioactive waste does not currently exist, there is no cemented PFR radioactive waste ready to be returned. A cementation facility for this radioactive waste is planned to be built at Dounreay but is not likely to be available for use prior to 2017. However, given that this waste has not yet been immobilised, the overseas customers could potentially still request that the PFR radioactive waste is vitrified rather than cemented. A decision would then need to be made as to whether designing, building, operating and eventually decommissioning a vitrification facility at Dounreay to satisfy these contracts, at significant cost to the UK taxpayer, would be required to finalise these contracts. This means that none of the PFR radioactive waste will be available for return to the customers until at least 2017 when a cementation facility will be available. The PFR radioactive waste would have to remain at Dounreay

until this time even if customers had facilities in place to receive cemented radioactive waste. However the return of the PFR radioactive waste could be delayed even further if the decision was made to vitrify the PFR radioactive waste instead of immobilising it in cement.

3.6 Summary

3.6.1 Implementation of this proposed policy would allow the NDA to return an equivalent amount of radioactive waste from elsewhere within its estate. This would avoid the delays and potentially significant costs that would result from having to construct dedicated new plant just to process the very small amounts of radioactive waste stored at Dounreay which have been allocated under the overseas reprocessing contracts.

3.6.2 Any substitution of radioactive waste that takes place would be done on the basis that it was broadly environmentally neutral for the UK and this would be enforced by the environmental regulators. By implementing this proposed policy, the overseas contracts could be concluded on an earlier basis resulting in increased clarity for the NDA and Dounreay and a potential saving to the UK taxpayer. Any potential impacts on storage at Dounreay and shipment numbers are hard to determine at present as they will depend on what precise arrangements are made between the NDA and its overseas customers.

4. Proposed Policy Statement

4.1 Introduction

4.1.1 This chapter contains Government's proposed statement of policy for the substitution of radioactive wastes allocated to overseas customers under their reprocessing contracts at Dounreay.

4.1.2 In the 1980s and 1990s Dounreay entered into a number of

reprocessing plant which is due to be encapsulated in cement by the end of 2013. Where the return of vitrified radioactive waste from Sellafield is not acceptable to customers, enabling a single type of cemented radioactive waste to be returned to these customers would simplify arrangements, allow radioactive waste to be returned as soon as practicable and give Dounreay greater clarity of its future radioactive waste management requirements.

4.1.6 Government believes that there are significant benefits to be gained by allowing the NDA to substitute vitrified radioactive wastes from Sellafield in place of cemented radioactive wastes from its MTR and PFR reprocessing plant at Dounreay and also allowing, where necessary, cemented MTR radioactive wastes to be substituted in place of PFR radioactive wastes. It therefore proposes to issue the policy statement below.

4.2 Coverage of the policy

4.2.1 This policy statement covers radioactive waste allocated to overseas customers for return under their nuclear fuel reprocessing contacts at Dounreay.

4.3 The Policy

4.3.1 The aim of this policy statement is to set down the Government's position on the substitution of radioactive wastes at Dounreay arising from the reprocessing of overseas nuclear fuels, known as 'raffinate'.

4.3.2 Government policy remains that the radioactive wastes resulting from the reprocessing of overseas spent fuel at Dounreay under those reprocessing contracts signed since 1976 should be returned to the country of origin. This should be carried out as soon as practicable after the radioactive waste has been produced.

4.3.3 Government accepts that the circumstances at Dounreay have changed markedly since the United Kingdom Atomic Energy Authority entered into contracts with overseas customers to reprocess nuclear fuels. As a result alternative means of satisfying contractual obligations should now be considered in order to allow these obligations to be discharged as soon as reasonably practicable.

4.3.4 Substitution of Prototype Fast Reactor (PFR) and Cemented Materials Test Reactor (MTR) raffinate wastes from Dounreay with a

radiologically equivalent amount of vitrified radioactive waste from Sellafield is permitted subject to contractual agreement with overseas customers and approval from the environmental regulators.

4.3.5 Substitution of Prototype Fast Reactor raffinate waste with a radiologically equivalent amount of cemented Materials Test Reactor raffinate is also permitted subject to contractual agreement with overseas customers and approval from the environmental regulator.

4.3.6 In both cases Government expects broad environmental neutrality to be maintained, primarily on the basis of radiological equivalence. Government will not specify the methodology used to determine radiological equivalence but expects the environmental regulators, the Environment Agency and the Scottish Environment Protection Agency to be satisfied that the arrangements between the NDA and its overseas customers meet this requirement.

5. Questions for Consultees

Question 1	<p>Do you agree that a waste substitution policy should be adopted for radioactive waste arising from overseas research reactor fuel reprocessing contracts at Dounreay?</p> <p>YES / NO / IN PART / NOT SURE</p> <p>Please provide additional comments, where necessary, to support your answer.</p>
Question 2	<p>Do you agree that substituting cemented Materials Test Reactor radioactive waste for Prototype Fast Reactor radioactive waste should be an available option to finalise the overseas contracts?</p> <p>YES / NO / IN PART / NOT SURE</p> <p>Please provide additional comments, where necessary, to support your answer.</p>
Question 3	<p>Do you agree that substituting vitrified radioactive waste from Sellafield for cemented Materials Test Reactor radioactive waste and/or Prototype Fast Reactor radioactive waste should be an available option to finalise the overseas contracts?</p> <p>YES / NO / IN PART / NOT SURE</p> <p>Please provide additional comments, where necessary, to support your answer.</p>
Question 4	<p>Do you agree with the proposals to ensure broad environmental neutrality for the United Kingdom?</p> <p>YES / NO / IN PART / NOT SURE</p> <p>Please provide additional comments, where necessary, to support your answer.</p>
Question 5	<p>Do you agree that all of the relevant implications of the proposed policy have been identified?</p> <p>YES / NO / IN PART / NOT SURE</p> <p>Please provide additional comments, where necessary, to support your answer.</p>

Appendix A Abbreviations

BNFL	British Nuclear Fuels Limited
DECC	Department of Energy and Climate Change
DFR	Dounreay Fast Reactor
DSRL	Dounreay Site Restoration Limited
HAW	High Activity Radioactive Waste
HLW	High Level Radioactive Waste
ILW	Intermediate Level Radioactive Waste
LLW	Low Level Radioactive Waste
MTR	Material Test Reactor
NDA	Nuclear Decommissioning Authority*
PFR	Prototype Fast Reactor
SEPA	Scottish Environment Protection Agency
UKAEA	United Kingdom Atomic Energy Authority

*see <http://www.NDA.gov.uk>

Appendix B Glossary of Terms

Low Level radioactive Waste (LLW): LLW is the lowest activity category of radioactive waste, and was defined in the March 2007 Government LLW policy statement as:

**“ Radioactive waste having a radioactive content not exceeding four gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma activity”.*

Intermediate Level radioactive Waste (ILW): ILW is radioactive waste with radioactivity levels exceeding the upper boundaries for LLW (see above) but which does not generate enough heat for this to need to be taken into account in the design of storage or disposal facilities

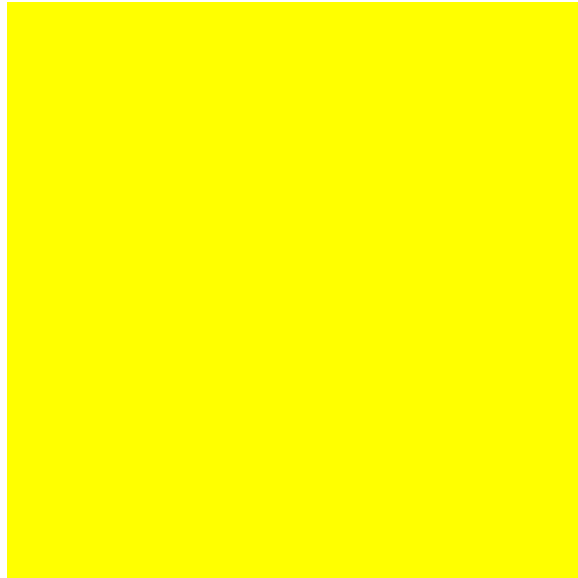
High Level radioactive Waste (HLW): Because of its high radioactivity, HLW generates heat, which has to be taken into account when designing storage and disposal facilities

Raffinate: The acidic radioactive wastes (liquors) left behind after reprocessing are known as raffinates. At Dounreay these are grouped into three distinct categories depending upon which reactor was the source of the fuel: the Materials Test Reactor (MTR), Dounreay Fast Reactor (DFR), or Prototype Fast Reactor (PFR).

Shielded underground tanks were built to store the raffinates. In the case of PFR raffinate, which was classified as High Level (heat generating) radioactive Waste, tanks were installed complete with cooling systems to prevent overheating. PFR raffinates have since undergone sufficient radioactive decay such that they are now classed as ILW. MTR and DFR raffinates were generated as Intermediate Level radioactive Waste and have therefore never required cooling during storage.

MTR raffinate: UKAEA designed and commissioned a cementation plant at Dounreay to solidify the MTR raffinate. The plant neutralises MTR raffinate with caustic soda and mixes it with a blend of cementitious powders in a 500-litre drum in a “cold” process. When the mixture has set, the drum becomes conditioned Intermediate Level radioactive Waste, or ILW. In this form the radioactive waste is safe for transport, long-term storage and/or disposal. Present estimates indicate that it will take until 2013 to complete the cementation of all MTR raffinate.

**Figure 8 – Cutaway Cement Drum from Dounreay Cementation Plant
(Courtesy DSRL)**



PFR raffinate: PFR fuel achieved a much higher burn up (the number of fissions that have taken place) and operated at a higher energy rating (the amount of heat produced by each gram of fuel) than DFR fuel (MTR fuel produced little energy at all). As a result the raffinate produced by reprocessing PFR fuel contains significantly more fission products, which give it more radioactivity and cause it to generate heat. Although the PFR operated more recently than the DFR, sufficient time has passed to allow the fission products to decay naturally thereby reducing radioactivity and heat. Whilst it was originally HLW this decay means that it is now classed as ILW.

Vitrification: In the UK immobilisation of high level, heat generating, liquid radioactive waste is achieved through vitrification. In this process liquid radioactive waste is turned into solid glass blocks. The high level liquid radioactive waste is turned into powder and mixed with molten glass at high temperature. The molten mixture is poured in to stainless steel canisters, where the glass solidifies, effectively locking-in the high level radioactive waste in a stable form suitable for disposal. The stainless steel canisters are welded shut and cleaned, prior to storage. In this form, the radioactive waste products are expected to be immobilised for a very long period of time (many thousands of years).

Appendix C References

¹ Cm 2919 Review of Radioactive Waste Management Policy: Final Conclusions, July 1995

² DTI: Intermediate Level Radioactive Waste Substitution, December 2004

³ 'New Treatment Plant': <http://www.dounreay.com/waste/radioactive-waste/intermediate-level-waste/new-treatment-plant>

⁴ 'Dounreay Lifetime Plan – Research and Development Programme from 2009: http://www.dounreay.com/UserFiles/File/Lifetime%20Plan%20etc/2008_Dounreay_TBURD_free_release_issue_1_25_9_08.pdf

⁵ Stage 2 Letter of Compliance Submission for PFR Raffinate. UKAEA Report APEC(05)459 Issue 1.

⁶ <http://www.sellafieldsites.com/UserFiles/File/Vitrified%20poster.pdf>

⁷ 'New Treatment Plant': <http://www.dounreay.com/waste/radioactive-waste/intermediate-level-waste/new-treatment-plant>



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DOUNREAY RADIOACTIVE WASTE SUBSTITUTION CONSULTATION 2010

RESPONDENT INFORMATION FORM

Please Note this form **must** be returned with your response to ensure that we handle your response appropriately

1. Name/Organisation

Organisation Name

Title Mr ☐ Ms ☐ Mrs ☐ Miss ☐ Dr ☐ *Please tick as appropriate*

Surname

Forename

2. Postal Address

<input type="text"/>		
<input type="text"/>		
<input type="text"/>		
<input type="text"/>		
Postcode	Phone	Email

3. Permissions - I am responding as...

Individual ☐ / Group/Organisation ☐

Please tick as appropriate

(a) Do you agree to your response being made available to the public