

Packaging of Sellafield Legacy Ponds Miscellaneous Beta-Gamma Waste

(Conceptual stage)

Summary of Assessment Report

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Introduction

British Nuclear Group Sellafield Ltd (BNGSL) has sought Conceptual stage endorsement for the packaging of Sellafield Legacy Ponds Miscellaneous Beta-Gamma Waste (MBGW), hereafter called Legacy Ponds MBGW. This waste arises from the Pile Fuel Storage Pond and the Magnox Fuel Storage Pond and Decanning Facility at Sellafield.

This document summarises the results of the assessment carried out by Radioactive Waste Management Directorate of the Nuclear Decommissioning Authority (NDA RWMD) in response to the submitted proposals to package Legacy Ponds MBGW. The assessment has been carried-out as part of the Letter of Compliance process, whereby NDA RWMD examines the disposability of the proposed waste packages by assessment against intermediate level waste packaging standards and the underpinning Phased Geological Repository Concept (PGRC). Further information on the Letter of Compliance process is available elsewhere¹.

A Conceptual stage disposability assessment has been conducted and this Assessment Report produced.

Background

The Pile Fuel Storage Pond facility comprises an open air, reinforced concrete cooling pond, and a structural steel framed de-canning building on the south side of the pond. The facility was built in 1949/50 and was commissioned and operated from 1951 to 1962 to de-can and store irradiated fuel discharged from the Windscale Piles. The facility continued in use until the early 1970's being used for the continued storage and de-canning of Pile and Calder Hall Magnox fuel, and a number of storage purposes including irradiated materials and general items of intermediate level waste arising from Sellafield site. The pond also contains redundant fuel skips, although these skips do not form part of the current packaging proposals.

The Magnox Fuel Storage Pond and Decanning Facility was constructed in 1958 to replace the Pile Fuel Storage Pond as a fuel storage and de-canning pond. During its operation, the Magnox fuel was passed through to reprocessing plants after decanning at the pond. The last transfer of fuel was made in July 1998. Routine operations in the Magnox Fuel Storage Pond and Decanning Facility pond ceased in 1986 when the Fuel Handling Plant took over operational de-canning and fuel storage. De-canning processes were initially carried out underwater in bays, but a dry cave de-canning process at the Magnox Fuel Storage Pond and Decanning Facility eventually superseded this system. The pond is open to the atmosphere. The facility is made up of four areas – Import Export Facility, Main Pond,

¹ Guide to the Nirex Letter of Compliance Process, Nirex Document WPS/650, June 2006.

De-canner caves and Wet Bays. The main pond was used for Fuel storage in skips, some stacked 2 or 3 high. The wet bays contained underwater de-canning cells, linked to the main pond by trolley systems and also consisted of skip transfer bays, main bays and withdrawal bays. With introduction of dry de-canning, the Wet Bays were subsequently used for a variety of purposes. It includes a wide variety of contaminated items, although does not appear to contain any irradiated MBGW according to descriptions of the waste within the submission.

The waste forms parts of waste streams 2D12, 2D14 and 2D15 identified in the UK Radioactive Waste Inventory. The Magnox Fuel Storage Pond and Decanning Facility also contains pond skips, some of which are proposed to form a component of the waste transfer process and waste packages. Pond skips containing zeolite ion exchange material are not addressed by this proposal and are being given separate consideration.

Packaging Proposals

For wastes stored in pond skips, the skip would be retrieved from its pond position and visual examination used to compare the skip and contents with plant records. The skip and contents would be washed to remove bulk sludge, although the methods that would be employed and likelihood of success are not described.

In the main pond of the Magnox Fuel Storage Pond and Decanning Facility, holes would be drilled in pond skips containing MBGW to allow water to drain when received at the packaging plant (Box Encapsulation Plant, BEP). In the de-canning area (bays) of the pond, waste would be re-packaged into nominal 350-litre liners, potentially allowing additional waste characterisation, and also sorting and segregation if required.

In the Pile Fuel Storage Pond, skips would be emptied and waste re-packaged into nominal 250-litre liners, potentially allowing additional waste characterisation, and also sorting and segregation if required. Large pond items would be size-reduced for transfer to BEP.

On receipt at BEP each skip or liner would be allowed to drain cover water into the transfer flask, and the skip or liner imported to the Waste Treatment Cell. The skip or liner would be subject to limited visual examination and weighed. BNGSL propose that if they have insufficient confidence in plant records the waste would be sorted to ensure fuel, fuel residues, Magnox or aluminium cladding and isotope cartridges are removed for separate treatment. Then, dependent upon the reliability of plant records it may be necessary to identify, process and estimate the following materials to ensure acceptable package limits are not breached:

- organic materials – they may either be loaded directly back into the skip or would be low force compacted into pucks and the pucks loaded into the skips for packaging;
- aluminium;
- closed containers – these would be punctured to enable drainage and subsequent grout infiltration;
- oils – attempts would be made to drain oil from pumps and gearboxes if a disposal route for the oil can be established, otherwise items will be packaged with their oil;
- graphite from the Pile Fuel Storage Pond would be quantified, and controlled if necessary, to comply with Wigner energy limits;

Any other materials determined to be Wastes Requiring Additional Treatment (WRAT) not identified above, would be segregated from the process until an approved conditioning and disposal route is agreed.

One skip would be placed centrally in a standard 3m³ Box disposal container. Liners would be buffer stored, until sufficient are available to fill a box (probably 4 per box).

An antifoatation plate would then be fitted to the box to prevent waste flotation during the grout encapsulation process. At the grouting station the wastes would be encapsulated and then capped after grout curing with a second pour of encapsulation grout. The box would subsequently be lidded, swabbed, washed if necessary, and moved to the Box Encapsulation Plant Product Store (BEPPS).

In total, a volume of 2177m³ Legacy Ponds MBGW is predicted to arise. This will lead to the production of some 1782 3m³ Boxes.

Assessment of Disposability

The disposability assessment conducted by NDA RWMD considers the proposed waste packages for compliance with the Phased Geological Repository Concept (PGRC). This is achieved by assessing the proposed waste packages against published generic safety assessments that address transport of waste packages to the facility and safety of operations at the facility. The wastes and packages are also assessed against the generic post-closure performance assessment.

Assessment Inventory

The Assessment of Disposability is based upon radioactive and physical/chemical inventory information provided by BNGSL in the submission documentation and within the UK Radioactive Waste Inventory, enhanced where possible by NDA RWMD.

Although the proposals give a picture of the typical contents of MBGW and the likely volumes of waste arising, there are some inconsistencies and uncertainties. The Legacy Ponds contain a wide range of materials, including spent fuel, corrosion product sludge, reactive metals and isotope cartridges that have content and characteristics very different from typical MBGW. For future submissions, further work will be needed to clarify which items are a component of MBGW, and which are to be diverted for an alternative waste treatment and packaging process. The submission also reported a revised volume for the MBGW arising from the Magnox Fuel Storage Pond and Decanning Facility compared to that reported in the UK Radioactive Waste Inventory, which suggests the volume of MBGW is much greater than previously indicated.

Proposals for Waste Characterisation and Records

BNGSL has made a commitment within the submission document that all requirements in respect of waste characterisation and production of waste package records (data recording) will be satisfied and that further details will be available at the Interim stage submission. Some very high level proposals on data recording have also been provided in the submission. NDA RWMD judges that it should be possible to obtain the necessary information on waste packages, although further developments are required to satisfy all requirements in respect of data recording. Early further development of the proposals will be important as the project progresses, since data recording methods have implications for the waste retrieval and packaging process.

NDA RWMD would expect that full data recording proposals be generated for the Interim stage LoC, and expects to discuss development of such proposals with BNGSL prior to future submissions.

Waste Container

The design of box to be utilised for the MBGW has not been specified in detail at this stage, but is proposed to be a version of the standard 3m³ Box proposed to be developed for use on Sellafield site. This is intended to be a corner lifting variant of a 3m³ box, to be made to meet the requirements of the Generic Waste Package Specification (GWPS). BNGSL has agreed

to seek formal endorsement of the box design once prototype testing and performance modelling is complete and prior to procurement.

Transport Safety

The assessment of Transport Safety showed that it should be possible for the proposed packages of Legacy Ponds MBGW to comply with all relevant transport safety criteria if transported in a Type B transport container with 285mm thick walls, such as the SWTC-285.

Operational Safety

Similarly, the assessments of Operational Safety showed that it should be possible for the proposed packages of Legacy Ponds MBGW to be handled and stored safely within a repository based on the PGRC.

Post-Closure Safety

The post-closure safety assessment revealed only one area of concern that could prejudice disposal of the proposed packages. The MBGW from the Pile Fuel Storage Pond contains some irradiated metals. Like other irradiated metals found widely in intermediate level wastes, they will contain carbon-14. The assessment has identified that if the carbon-14 is released in the gaseous form could make a significant contribution to the risk target against which the PGRC is judged. The predicted rate of generation of carbon-14 labelled methane from these wastes is not unusually high for ILW containing irradiated metal, but is still potentially significant to post-closure safety. This is a generic issue, which is being addressed in a coordinated programme², much being undertaken by the NDA RWMD.

The waste may also contain oils from gearboxes and pumps. Even though the quantity of oils may not prejudice disposal, an estimate of the maximum quantity is required to allow detailed assessment of its significance. Pursuit of alternative treatment and disposal routes has also been encouraged by NDA RWMD.

Generic Waste Package Specification

The proposed packages are demonstrated to be consistent with the requirements of the NDA RWMD Generic Waste Package Specification and have been judged to follow established good practice in most respects. Further work is required on management of oils that might be present in MBGW, and enhancement and development of proposals for characterising the wastes and producing package records.

Requirements for Further Work

A number of technical issues have been identified as requiring resolution prior to the proposals being endorsed at Interim stage. These Action Points relate to:

- clarification of which pond wastes are included as MBGW and attention to the predicted volume of waste arising from the Magnox Fuel Storage Pond and Decanning Facility;
- improvements to the radiochemical inventory for assessment, including justification for the contribution from the estimated sludge carryover with MBGW;
- improvement and detailed development of the data recording methodology;
- provision of estimates of the maximum quantity of oils that could be present in MBGW to allow detailed assessment, and the need for BNGSL to pursue alternative treatment and disposal routes for oils;

² Nirex, *The Viability of a Phased Geological Repository Concept for the Long-Term Management of the UK's Radioactive Waste*, Nirex report N/122, November 2005.

- confirmation of the proposed cementitious grout formulation and information regarding key product parameters;
- evidence and arguments to support waste package longevity;
- details of box specifications and drawings;
- details of liner and box furniture to appropriately locate liners and skips;
- details of the liners and show how they are designed to drain effectively;
- confirmation of the adequacy of the quality management system;
- the provision of details of the proposed waste package storage environment; and
- provision of draft Waste Product Specification and Criticality Compliance Assurance documents.

Conclusions

A Conceptual stage assessment of BNGSL's proposals for packaging MBGW from the Pile Fuel Storage Pond and the Magnox Fuel Storage Pond and Decanning Facility has been carried out. The assessment has concluded that the proposed packages should be compatible with the PGRC. Consequently, NDA RWMD is able to endorse the proposed packaging of Sellafield Legacy Ponds MBGW at the Conceptual stage through the issue of a Letter of Compliance.

The volume of Legacy Ponds MBGW is significant, but this waste is not significant in terms of its radionuclide content relative to most other intermediate level wastes and especially to other Sellafield legacy wastes, on the assumption that non-MBGW wastes such as spent fuel are reliably identified and excluded. The NDA RWMD judges that the current proposals would be classified as Category Y³ by the regulators, as defined in the regulators guidance for the management of radioactive waste on nuclear licensed sites, February 2007.

³ Category Y is defined as projects that the regulators will not wish to assess, other than on a sampling basis