

Packaging of Berkeley Active Waste Vaults – Mobile Waste

(Interim stage)

Summary of Assessment Report

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Introduction

British Nuclear Group Magnox Electric Ltd (MEL) has sought Interim stage endorsement for the packaging of Ion exchange resins, Sludges and filter materials, which have arisen due to active operations at the Berkeley Decommissioning site. Operations at Berkeley have included research undertaken at the Berkeley Technical Centre and electricity generation at Berkeley Magnox Power Station. The proposed packaging process comprises retrieval and transfer of the wastes into Nirex standard 3m³ Drums and immobilisation by mixing with cement powders.

This document summarises the results of the assessment carried out by Nirex in response to the submitted proposals. The assessment has been carried out as part of the Letter of Compliance process, whereby Nirex examines the disposability of the proposed waste packages by assessment against intermediate level waste (ILW) packaging standards and specifications and the underpinning Phased Geological Repository Concept (PGRC). Further information on the Letter of Compliance process is available elsewhere¹.

The process of obtaining a Letter of Compliance is embedded in the regulators' arrangements for the conditioning and packaging of ILW, as described in the guidance issued by the regulators^{2,3 & 4}.

Background to assessment

MEL has tendered an Interim stage submission relating to the packaging of the 'mobile' fraction of the wastes retrieved from the active waste vaults on site at Berkeley Decommissioning Site.

The submission identifies the following mobile waste types:

- Ion exchange material;
- Celite filter pre-coat material;

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

² *Improved Regulatory Arrangements for the Conditioning of Intermediate Level Radioactive Waste on Nuclear Licensed Sites: Provision of Advice to the Health and Safety Executive by the Environment Agency and the Scottish Environment Protection Agency, Regulators' Position Statement, December 2003.*

³ *Conditioning of Intermediate Level Radioactive Waste on Nuclear Licensed Sites: Provision of Advice by the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency, Guidance to Industry, March 2005.*

⁴ *The regulation of radioactive waste management on licensed nuclear sites, Advice by the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency, Guidance to Industry, November 2006.*

- Pond sludge material.

The submission is a companion to the separate Interim stage submission that dealt with the solid fraction of the waste retrieved from the active waste vaults. An Interim stage Assessment was undertaken, and an Assessment Report provided. Currently work is in progress to resolve outstanding actions, prior to the issue of an Interim stage Letter of Compliance.

The filter pre-coat material, Celite comprises a fine powder, applied as a particulate filter coating material and used for pond water treatment. The Celite was dosed with cobaltic cyanide to assist in the absorption of radioactive caesium. The Celite was routinely removed from the filters, containerised and transferred to the waste vaults for storage.

Pond Sludge comprises predominantly magnesium hydroxide, graphite dust and filter coating material. The Sludge arises from filtration of liquid effluents prior to treatment and includes magnesium-based precipitates derived from the corrosion of Magnox fuel cladding. In addition Sludge is present from the re-generation of Ion exchange units. The Sludges were routinely removed, containerised and transferred to the waste vaults for storage.

Ion exchange resin, which is known by the trade names; Lewatit DN and Decalso Y/Duocil, was used for pond water treatment to remove dissolved activity, principally caesium ions. The resin is based on a phenol-formaldehyde structure and is present in a spherical bead form. In addition there is a smaller fraction of polystyrene mixed bead resin, which is known by the trade name IRN 150. The Ion exchange materials were routinely removed from the treatment units, containerised and transferred to the waste vaults for storage.

Packaging proposals

The proposed packaging process would involve the co-packaging of mobile wastes from the three different sources: Ion exchange material, Sludges and Celite by in-drum mixing with cementitious powders in a 3m³ Drum waste container. Solid and potentially mobile wastes will be segregated on retrieval from the storage vaults and diverted to the appropriate processing cell. The retrieval and packaging process can be described as follows:

- Containerised and loose retrieved mobile waste, would first be passed through a shredder.
- Resultant waste feed would be screened; mobile wastes are those that pass through the 5 mm screen. Wastes retained on the screen would be sentenced to the solid waste treatment process (covered by separate assessment)
- Celite and Ion exchange material would be sentenced to segregated collection vessels, referred to as intermediate bulk containers. Sludge would be sentenced to a separate collection tank.
- The mobile wastes would be transferred to a 3m³ Drum waste container, in specified and known proportions of Celite, Ion exchange material and Sludge. The target volume of waste per drum would be 1600 litres.
- The cement powders would be added to the 3m³ Drum and mixed with the waste using an in-drum paddle.
- The in-drum paddle would continue to rotate for a period after the addition of constituents, to ensure production of a homogeneous conditioned wasteform. The paddle would be stopped and the wasteform allowed to cure.
- The wasteform would be allowed to cure for approximately 16 hours, then capped with in-active cement grout.
- Finally, each drum package would be fitted with a lid and subject to quality checks before transfer to a new purpose built ILW storage facility.

The proposed packaging process would lead to the production of 79 off 3m³ Drums, which amount to a total volume of approximately 205 m³, with an average package radionuclide inventory at 2040 of 7 A₂ multiples⁵ and a maximum package inventory of 1,210 A₂ multiples. When compared to a reference case conditioned volume of Unshielded ILW for the 2001 National Inventory of 152,000 m³ of waste in total, the Berkeley mobile waste would constitute 0.15% of the volume and no individual radionuclide would contribute more than 0.5% of the inventory considered in the most recent geological disposal performance assessment.

Assessment of Disposability

The acceptability of the proposed packages has been assessed against criteria established within the Nirex PGRC and associated Generic Waste Package Specification (GWPS).

The Assessment of Disposability is based upon the radionuclide and physical/chemical inventory data supplied by MEL, which has been derived from sampling and radiochemical analysis undertaken on the waste. This position has been accepted as consistent with expectations at the Interim LoC assessment stage.

The proposed 3m³ Drum waste packages examined herein are, at this Interim stage, judged to be generally consistent with Nirex standards and specifications for waste packages. Numerous analogues of the proposed wasteform are available and the associated development work assessed previously by Nirex provides confidence that an adequate wasteform could be produced for the Berkeley mobile waste.

The assessments of transport safety show that it should be possible for the 3m³ Drum packages containing Berkeley mobile waste to comply with all relevant transport safety criteria when transported using the Nirex Standard Waste Transport Container (SWTC). It is noted that the on-site conditioned waste storage facility should be designed to provide access and compatibility for the interfaces of the SWTC, to enable transfer of the waste packages to any future disposal facility.

Similarly, the assessments of operational safety also show that it should be possible for 3m³ Drum packages containing Berkeley mobile waste to be handled and stored safely within a repository design concept based on the PGRC.

The post-closure safety assessment revealed no significant areas of concern that could prejudice disposal of packages containing Berkeley mobile waste. This is due to the relatively small number of packages containing the materials, and the relatively low and short-lived radionuclide inventory associated with them.

The waste stream includes fuel pond Sludge and is expected to contain some fuel related materials. A simple Criticality Compliance Assurance Document will need to be developed for the proposed packages, to demonstrate that the waste would not present a criticality hazard.

In summary, the Assessment of Disposability has concluded that a Disposability Safety Case could ultimately be made for packages containing Berkeley mobile waste.

Requirements for further development work

The submission document states that the following waste package data issues will be included in future submissions:

- A detailed description of proposals for waste sampling and analysis;
- A methodology for production of data records for the content of each package;
- A finalised Waste Product Specification;

⁵ A₂ multiples provide a measure of the activity content of transport packages, where each radionuclide is weighted according to its damage potential.

- A Criticality Compliance Assurance Document.

Nirex welcomes MEL's intention to address these points in detail, and to include the findings in the future Final stage submission.

Conclusions

Consistency of the proposed Berkeley mobile wastes with the Phased Geological Repository Concept has been assessed and an Interim stage Disposability Assessment produced. In assessing the Interim stage proposal, Nirex has identified a number of issues that would need to be undertaken as part of a future development linked to plant design and results included at the Final stage for Nirex assessment.

Some of the issues identified require further work to be undertaken now before Nirex can determine whether the proposal can be endorsed by the issue of an Interim stage Letter of Compliance. In particular, at the Interim stage, it is considered that additional clarification is required for:

- Derivation and assignment of waste packaging inventory;
- Methodology for waste sampling and analysis;
- Justification for range of wasteform formulation trials.

On the basis of the submitted information, the assessment of the proposal has concluded that further work is required to be undertaken, to demonstrate that the proposed packages will be compliant with the requirements of the Nirex Phased Geological Repository Concept (PGRC).