Radioactive Waste Management Directorate

Packaging of Bradwell Wet ILW

(Conceptual stage)

Summary of Assessment Report

Issue date of Assessment Report: 12 July 2007

Background

Magnox South has sought Conceptual stage endorsement for waste packages proposed to be made as a result of conditioning sludges and ion exchange materials (collectively known in this report as "Wet ILW") that has arisen during the operation of the Bradwell Power Station. These wastes have been stored within tanks located below ground, within shielded concrete structures, in the Active Waste Vaults.

This document summarises the results of the assessment carried out by NDA Radioactive Waste Management Directorate in response to the submitted proposals. The assessment has been carried-out as part of the Letter of Compliance process, whereby NDA examines the disposability of the proposed waste packages by assessment against intermediate level waste (ILW) packaging standards and specifications and the Phased Geological Repository Concept (PGRC). Further information on the Letter of Compliance process is available elsewhere[1].

Scope of the Proposals

Magnox South has proposed a number of options for the processing of these wastes, two of which have been assessed in detail. Option A involves the encapsulation of the sludges and resins in a cementitious matrix with minimal pre-treatment whereas Option B involves the use of a process to dissolve the sludge and metallic contents of the Fuel Element Debris (FED) vaults and mixing of the resultant "FED dissolution sludge" with the other Wet ILW streams and condition by mixing in a cementitious matrix.

The waste comprises the wet ILW that has arisen during the operation of the Bradwell Site and is in the form of ion exchange resin or sludges from the Pond Water Treatment Plant (PWTP) and the Active Effluent Treatment Plant (AETP). Future arisings of Wet ILW (included within the scope of this assessment) include Fuel Element Debris (FED) Magnox sludge arising from the aqueous corrosion of the solid FED material on site, continuing pond filter back-washes from the AETP, PWTP and Pond Filter Sand and Ion Exchange Resins from the Caesium Removal Unit. Should Option B be pursued, the waste arising from the FED dissolution would also be within the scope of these proposals.

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

Packaging Proposals

Magnox South has requested that waste packages produced by two different packaging processes be assessed.

In 'Option A' FED corrosion sludge would be processed along with the ion exchange materials and sludge. The Option A packaging process can be summarised as:

1. Retrieval of wastes from Settling Tanks using a process of agitation and pumping.
2. Ion exchange material waste mixed with either PWTP/AETP sludge or FED corrosion sludge.
3. Mixed wastes and premixed 3:1 blast furnace slag (BFS)/ordinary Portland cement (OPC) added to $3m^3$ Drum waste container.
4. Waste and cement powders mixed using a 'lost' paddle.
5. Wasteform left to cure.
6. Cured matrix capped using 9:1 BFS/OPC. Allowed to cure.
7. $3m^3$ Drum lidded, decontaminated and transported to ILW package store.

For 'Option B' the solid Magnox FED would go through a dissolution process, and the resultant FED dissolution sludge would be processed along with the ion exchange material and sludge. The Option B packaging process can be summarised as:

1. Retrieval of wastes from Settling Tanks using a process of agitation and pumping.
2. Retrieval of FED Magnox and any associated corrosion sludge.
3. FED Magnox and any associated sludge put through dissolution process.
4. Dissolution plant back-washes retrieved via process of agitation and pumping.
5. Ion exchange material waste mixed with either PWTP/AETP sludge or FED dissolution sludge.
6. Mixed wastes and premixed 3:1 BFS/OPC added to $3m^3$ Drum waste container.
7. Waste and cement powders mixed using a 'lost' paddle.
8. Wasteform left to cure.
9. Cured matrix capped using 9:1 BFS/OPC. Allowed to cure.
10. $3m^3$ Drum lidded, decontaminated and transported to ILW package store.

This Assessment Report details the RWMD assessment of these proposals for Bradwell Wet ILW.

Assessment of Disposability

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

The Assessment of Disposability is based upon a set of radionuclide inventories derived by RWMD using a series of assumptions of waste composition. Magnox South will be required to confirm that these derived inventories are suitably representative of the Bradwell Wet ILW.

It is expected that a suitable wasteform could be produced from the encapsulation of the sludges and resins, provided that Magnox South can provide an effective means of removing any oil that may be associated with the wet wastes, prior to encapsulation.

The assessments of Transport Safety show that it would be possible for packages containing Bradwell Wet ILW to comply with all relevant criteria if transported in 285 mm thick walled Type B transport containers such as the Standard Waste Transport Container (SWTC)-285.

A scoping calculation has indicated the radioactive gas release rates could exceed the limit of $1x10^{-6}$ A_2/hr for a consignment by a substantial factor, although it is expected that this is as a result of the use of a very conservative inventory value for Cl-36. It is anticipated that a more realistic assessment methodology or a more realistic inventory determination for that radionuclide would demonstrate the release rates were within limits.

The assessments of operational safety show that it should be possible for $3m^3$ Drums containing Bradwell Wet ILW to be handled and stored safely within a repository based on the PGRC. The current assessments indicate that assessed doses could potentially represent significant fractions of the limits applied by NDA, although as in the transport assessment, this is primarily due to an over-estimate of the Cl-36 inventory. Furthermore, consideration of the conservatisms in the assessments and expected future revisions to methodologies and assumed parameters would be expected to reduce the assessed doses considerably. It is concluded that this provides robustness against any future revisions to risk or dose targets.

The post-closure safety assessment has revealed no areas of concern that should prejudice disposal of packages containing Bradwell Wet ILW. The waste under consideration currently includes a total of 230 kg of oil. Any oils remaining in the Bradwell Wet ILW inventory will be intimately mixed with the encapsulant when packaged, and by mass will represent a small component of an average $3m^3$ Drum of this wastestream (up to 5kg per $3m^3$ drum). The potential impact of the Non Aqueous Phase Liquids present in Bradwell Wet ILW inventory on the behaviour of the wastestream, or on neighbouring packages in a repository, is expected to be minor. Furthermore, migration of oils potentially present in the Bradwell Wet ILW inventory is not considered likely.

In summary, the Assessment of Disposability has concluded that a Disposability Safety Case could ultimately be made for packages containing Bradwell Wet ILW. This assessment considered both Option A and Option B processing techniques.

Requirements for further development work

The following will need to be provided as part of any Interim stage packaging proposals for the Bradwell Wet ILW waste streams:

- Basis of the inventory derivation and production of a more realistic inventory, particularly for Cl-36;
- Should FED dissolution be pursued, evidence regarding the retention of radionuclides in the sludge and the composition of the sludge;
- Development of the draft Waste Product Specification;
- Investigation into the removal of oil from the sludge, or a demonstration that the oil can be adequately immobilised and evidence that gas generation due to radiolysis of oil is adequately low;
- Confirmation of details of the container design;
- Development of an appropriate wasteform formulation and demonstration that the proposed formulation is robust to potential variations in the waste and process;
- Development of appropriate data recording proposals, detailing proposals for retrieving, transferring, treating and conditioning the Wet ILW.

The above points have been raised as a series of Action Points within the Assessment Report.

Conclusions

The Conceptual stage proposals from Magnox South for the retrieval and packaging of Bradwell Wet ILW have been assessed.

The assessment has considered two potential processing options for the encapsulation of the Wet ILW: encapsulation with minimal pre-treatment and encapsulation following a FED dissolution process. The assessment concluded that both processing options would be expected to be consistent with disposal under the Phased Geological Repository Concept (PGRC) and can be endorsed at the Conceptual stage.

The consistency of the proposed waste packages with the PGRC has been demonstrated through the provision of an Assessment of Disposability (at this stage to be regarded as a draft of an eventual Disposability Safety Case).

A number of Action Points have been raised which will require to be addressed as part of any Interim stage proposals for the waste.