

WAGR Reactor Decommissioning Debris

(Final stage)

Summary of Assessment Report

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Introduction

Sellafield Ltd has sought final stage endorsement of proposals for the packaging of residual debris arising from decommissioning the Windscale Advanced Gas-cooled Reactor (WAGR). This is likely to constitute the final WAGR ILW packaging proposal.

This Assessment Report provides the basis and findings of the final stage disposability assessment by NDA Radioactive Waste Management Directorate (hereafter RWMD) for the WAGR debris waste package. The assessment has been carried out through the Disposability Assessment process, whereby RWMD examines the disposability of proposed waste packages by assessment against the requirements of the reference ILW disposal concept. This concept has been developed as part of the programme to implement geological disposal for the UK's higher activity wastes. Further information on the Letter of Compliance process is available elsewhere¹.

Background

In use between 1962 and 1981, the WAGR prototype Advanced Gas-cooled Reactor was selected as a pilot to demonstrate the safe decommissioning of a nuclear reactor. Between 1992 and 2006, 10 decommissioning campaigns produced a mixture of LLW and ILW waste packages. The ILW waste was grouted into 6 cubic metre reinforced concrete boxes (referred to here as the WAGR box).

Summary of WAGR ILW waste packages by campaign

Campaign	Description	Waste Package by type (predominant) and density		
		Steel	Graphite	Steel and graphite
2	Operational waste	7 HD		
4	Loop Tubes	6 HD		
5	Neutron Shield	2 HD	10 HD, 1 ND	
6	Core Graphite and Restraint	2 HD	14 HD, 41 ND	1 HD, 1 ND
7	Thermal Shield	15 HD		
7a	Lower Structures Phase I(Lower Thermal Shield)	6 HD, 1 ND		
8	Lower Structures Phase II	1HD, 1ND		

HD – High density version of box and grout

ND – Normal density version of box and grout

¹ NDA, Guide to the Letter of Compliance Process, NDA Document WPS/650, March 2008

Campaign 1 was essential concerned with preparations for remote decommissioning of the Hotbox (Campaign 3). Campaign 9 removed pressure vessel insulation (containing asbestos) and parts of the Tundish. Campaign 10 removed outer ventilation membrane and associated materials. Campaigns 1, 3, 9 and 10 resulted in LLW packages only and were disposed of accordingly. A final campaign 11 is planned to remove remaining structures in the vault as LLW, leaving the Bioshield concrete shell for demolition.

Receiving LoC endorsement for WAGR ILW campaigns from 1992 to 2006, the existing 109 ILW WAGR waste packages are included in the current reference DSSC assumptions for disposal in a shielded ILW vault.

Waste packaging proposal and scope of assessment

Comprising a mixture of materials from the decommissioning campaigns, the debris waste is made up of small pieces, fragments and particles of metal, graphite, plastic and insulation. These have been collected into 13 containers, including 6 catch pots, a central debris pot, 3 round bins, 2 general purpose bins and a vacuum cleaner. A shard of loop tube steel present in the sentencing cell would be recovered during operations for inclusion in the waste package. In order to ensure ALARP doses to workers the waste in the catch pots and vacuum cleaner would be pre-grouted before transfer to the package production facility. The other items would be transferred directly to the production facility. They would all be incorporated into one high density WAGR box using a high density grout formulation to provide shielding. The resulting waste package, an industrial package type 2 (IP-2) for transport, would be retained at the existing WAGR box store for an interim period before final disposal to a shielded ILW vault.

The assessment examined:

- the derivation of the assessment inventory and whether it was appropriate
- whether the wasteform to be produced is suitable for disposal and in particular any implication of incomplete incorporation of some debris into the wasteform.
- compliance with the level 3 waste package specifications, transport safety, operational safety and environmental safety requirements.
- the adequacy of quality management arrangements for package production and for the generation and maintenance of package records.

Outcome of assessment

The package arising from this proposal is consistent with previous use of the WAGR box, comprising debris material arising from the earlier campaigns which received RWMD endorsement.

The assessment inventory was concluded to be generally conservative, compensating appropriately for uncertainties in the mass of material and activities by use of suitably pessimistic waste loadings and pessimistic fingerprints for the graphite and activated metal components.

Although the assumption of no caesium inventory may be less pessimistic, it was concluded that the waste package inventory is modest compared to earlier WAGR ILW inventories and so the absence of Cs added little extra risk. Additionally, post manufacture monitoring of the package as part of the general monitoring programme would provide Sellafield Ltd with the opportunity to make any necessary risk management adjustments.

The properties of the wasteform, which due to the package production method may contain pockets of incompletely incorporated WAGR debris fines, were assessed to be acceptable. The box and box furniture designs result in a number of layers of containment for any pockets of fines and the product was concluded to be essentially monolithic, with properties similar to the earlier WAGR ILW products. Consequently, the release fraction values from the WAGR periodic review were used in the safety analyses.

The WAGR debris package generally meets the WPS specifications for the 6 cubic metre concrete waste package. Compliance with requirements for dimensions, mass and lifting features ensured compatibility of the package with the design requirements for disposal of shielded ILW in the current GDF concept.

The WPS requires that the package shall maintain integrity for 150 years and should for 500 years. The WAGR package design predates RWMD WPS requirements and its design life of 100 years is therefore a potential issue. It was concluded in the WAGR periodic review, and here, that package integrity and containment properties, which could be affected by ageing (through expansive corrosion) would not affect the package for some thousands of years. This is well in excess of the WPS requirement. The long term qualification of the lifting features could potentially be challenged if significant corrosion were to occur. However the WAGR periodic review accepted that lifting the package using its base, and stacking on blocks, would allow recovery of the packages beyond their design life, and so should not prevent endorsement. It was therefore concluded that a concession for this particular WAGR package from the WPS 150 years requirement could be offered without significant additional risk.

Sellafield Ltd will endeavour to source and use the superplasticisers specified in the proposal and WPrS. These were assessed as acceptable for use with the low alpha containing WAGR decommissioning wastes. Approval would be required from RWMD of any substitution before packaging.

Compliance with transport as an industrial package type 2 (IP2) was confirmed. The waste was assessed to be Low Specific Activity (LSA). The package complied with regulatory requirements for specific activity distribution, dose rate and activity release in normal and accident conditions. However it is noted that the Certificate of Approval for the WAGR box has lapsed and would need to be renewed before the package can be approved for transport. As a consequence, and consistent with the WAGR periodic review, RWMD will not offer a LoC until transport approval for the WAGR box has been resolved.

The assessment concluded that the operational safety performance of the package was acceptable with doses to workers and the public from all accident scenarios less than the most restrictive basic safety level, representing ALARP doses to workers and the public. Environmental safety performance was satisfactory with doses to the public below RWMD screening levels during GDF operations and the post-closure phase. Since the waste has no fissile radionuclide content, criticality safety is ensured.

Quality management arrangements documented in the package specific waste product specification (WPrS) were assessed as sufficient to ensure proper control of waste treatment and loading, of raw materials and of the packaging process. The previous history of the facility in producing 109 ILW packages from a variety of WAGR decommissioning waste also provided credible evidence for production of the proposed package.

A Nirex audit of packaging records in 2006 identified that there were some shortcomings in the WAGR packaging records. In response Sellafield Ltd produced a

WAGR Records Route-map in 2010, including extra documentation requirements for new packages. Inclusion of these extra records was concluded to be satisfactory.

Conclusions

Sellafield Ltd has sought final stage endorsement of proposals for the packaging of residual debris arising from decommissioning the Windscale Advanced Gas-cooled Reactor (WAGR). This is likely to constitute the final WAGR ILW packaging proposal.

This assessment report was prepared by RWMD to assess the proposal against the technical, legal and policy framework of the LoC process. This disposability assessment has concluded that that the proposed package is disposable under the geological disposal concept. Although there are no technical reasons to prevent endorsement the transport approval WAGR box has lapsed. As a consequence, and consistent with the WAGR periodic review, RWMD will not offer a final stage Letter of Compliance until transport approval for the WAGR box has been resolved.