

Retrieval and Packaging of Miscellaneous Beta/Gamma wastes from B243, Sellafield

(Conceptual stage)

Summary of Assessment Report

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Introduction

Sellafield Ltd has sought Conceptual stage endorsement of proposals for retrieval, interim storage, packaging and disposal of miscellaneous beta/gamma active wastes (MBGW) currently stored in eight concrete cells at Sellafield.

This Assessment Report summarises the conclusions of the assessment by NDA Radioactive Waste Management Directorate (hereafter RWMD) of the Conceptual stage submission for miscellaneous beta/gamma active waste. The assessment has been carried out as part of the Letter of Compliance process, whereby RWMD examines the disposability of the proposed waste packages by assessment against ILW packaging standards and specifications and the Geological Disposal Concept. Further information on the Letter of Compliance process is available elsewhere¹.

Background

The eight concrete cells containing the MBGW were originally constructed to house sand bed filters, which were never used and were subsequently removed. In 1970 it was decided that the eight cells would provide a suitable location for the storage of MBGW that was too active for disposal to the Low Level Waste Repository (LLWR) and too bulky for storage in the Original Dry Storage Silo. Consequently between 1970 and 1986 the eight cells were filled with MBGW.

Sellafield Ltd has proposed that the solid MBGW items currently stored in the storage cells would be retrieved, assayed and segregated into Intermediate Level Waste (ILW) and Low Level Waste (LLW). The LLW would be separated for onward disposal to the LLWR and the ILW would be placed into carbon steel liners, possibly following some degree of compaction or size reduction, as necessary. The steel liners would then be placed inside 3m³ stainless steel boxes for interim local storage in a purpose built store. At some point in the future, estimated to be between 5 to 10 years after emplacement, the 3m³ boxes would be consigned to an as-yet to be defined encapsulation plant for encapsulation (conditioning) of the waste. The encapsulation matrix has yet to be confirmed but this assessment has made the assumption that the wastes would be conditioned using a cementitious grout.

One of the key drivers for the MBGW retrievals project is a Licence Instrument Specification (LIS) issued by the Nuclear Installations Inspectorate. LIS 324 requires Sellafield Ltd to *"retrieve and store, in a place and manner acceptable to the Inspectorate, potentially mobile beta gamma waste currently held in eight concrete cells... ..by 1st August 2010."* In order to meet with this timescale, RWMD and Sellafield Ltd have developed a staged submission process for the assessment of these wastes within the LoC process. This Conceptual stage assessment has considered the concept of "packing" waste into the disposal container for

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

interim, unconditioned storage. A future assessment will be undertaken to consider the “packaging” step, when the wastes within the container are conditioned by the addition of an encapsulation matrix, currently assumed to be cement grout. This approach is considered to be appropriate given the requirement to retrieve and safely store the waste by 2010, and the uncertainties associated with the future availability of packaging plant(s).

Nature of the Waste

Only limited records exist for the waste that has been consigned to the eight concrete cells. As a consequence, it has only been possible to build up a partial picture of the origin and characteristics of the wastes at this time. In broad terms, the majority of the MBGW appears to take the form of scrap and trash that has originated as a result of operations involving the storage and reprocessing of irradiated Magnox fuel and the treatment of resulting radioactive liquid effluents. In addition, there are a large number of High Efficiency Particulate Air (HEPA) filters that arose from operations in a number of facilities on the Sellafield site, together with some wastes from post-operational clean-out (POCO) and decommissioning activities.

It is not possible to determine a definitive chemical inventory for the in-cell wastes due to the incomplete records. However, the bulk of the waste is expected to be metallic wastes with smaller amounts of concrete, wood, plastics, rubber, PVC, concrete and particulate materials (sand, soil, silt, sludge etc.).

Scope of the proposals

The volume of waste stored in the concrete cells is expected to give rise to approximately one hundred 3m³ Boxes of ILW.

The assessment has considered the compatibility of the proposed packages containing MBGW with the requirements for safe long-term management, including storage, transport, emplacement underground, and disposal.

This report represents RWMD advice on the disposability of the proposed waste packages based upon the standards and specifications developed from the Geological Disposal concept. In producing the Assessment of Disposability, due consideration has been given to safety and environmental protection requirements for transport, handling and disposal of the waste. RWMD expects the assessment of disposability could contribute to the licensee's Radioactive Waste Management Case as required by regulatory guidance, and specifically to the reasoned judgement that the conditioned waste will meet the anticipated requirements for acceptance from the potential disposal site operator.

The proposals to package the MBGW have been judged against regulatory guidance² and the view of RWMD is that these should be considered as MEDIUM priority for regulatory scrutiny. The principal reason for this judgement is due to the proposal to defer conditioning for up to ten years after packing the waste into disposal containers. In addition, there may be conflicts of interest between the regulatory driver to package the waste in short timescales and the need for effective characterisation at the time of retrieval. Sellafield Ltd is advised to seek the necessary interaction with regulators to confirm this position.

² *The Management of Radioactive Waste on Nuclear Licensed Sites – Part 1: The Regulatory Process*, Guidance from the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency to nuclear licensees, December 2007.

Technical Evaluation

For assessment purposes, it was assumed that the major components of the waste would be packaged separately. Accordingly, three waste package scenarios were developed: general scrap and trash, HEPA filters and particulates. For operational reasons, Sellafield Ltd has indicated a preference that the MBGW would not necessarily be segregated into different streams at source. Instead, the intention would be to co-package all categories of waste collectively. Although RWMD acknowledges this requirement, the three packaging scenarios were developed to enable a detailed evaluation of the technical issues affecting the disposability of the different waste categories. This approach does not preclude the potential for wastes to be co-packaged but instead provides an indication of package performance at the extremes of the waste envelope.

The technical evaluation indicates that there should not be any reason why the proposed approach would not be appropriate for packages containing general scrap and trash and HEPA filters. It is also quite feasible that these two categories could be co-packaged in any configuration. At future assessment stages, Sellafield Ltd will be required to demonstrate that a fully compliant wasteform could be produced from direct encapsulation of these wastes.

In the case of particulate wastes, the proposed approach of direct encapsulation inside the waste container was found to be unacceptable on two main grounds:

- The mechanical and physical properties of the wasteform is considered to be very poor and the potential for cliff-edge effects in package performance under accident conditions cannot be discounted. This is particularly significant given the potential for particulate wastes to possess high radionuclide inventories;
- There is a significant risk that free liquids could be associated with particulate wastes. As a result, the evolution of the waste package during interim storage would be unpredictable and it would be difficult to encompass the variation in liquid content to generate a suitable encapsulating matrix.

For the above reasons, it has not been possible to endorse the proposals for particulate wastes at the Conceptual stage. It will be necessary to provide some pre-treatment of particulate wastes before these could be endorsed for packing along with general scrap and trash and HEPA filters.

The proposed 3m³ Box waste container is a new design for use on a number of decommissioning projects across the Sellafield site and is subject to continuing development work. Consequently, it has not been possible to undertake a detailed assessment of the proposed container design at this time. Sellafield Ltd is expected to submit detailed design proposals for this container design later in 2008, once the prototype development work has been completed and performance data made available. The outcome of this generic design assessment will feed into the next assessment stage for the MBGW, which is expected to occur prior to the commencement of retrieval operations. This assessment has identified a number of design issues that are unique to the container variant that will be used to package the MBGW, and these will need to be addressed for the next assessment stage. These issues relate to the detailed design of the liner, the anti-flotation device and the venting arrangements.

Owing to the limited nature of the existing waste records, it will be necessary for Sellafield Ltd to provide a full characterisation of the waste. It is clear that the most appropriate opportunity to undertake this characterisation would be at the point of retrieval from the concrete cells and prior to emplacement in the 3m³ Boxes. Sellafield Ltd has proposed to carry out only limited characterisation work at the point of retrieval in order that the overall objective for clearance of the cells can be achieved within the timescales agreed with the regulators. There is a risk that this approach may be to the detriment of appropriate waste management. Subsequent characterisation work on the contents of the waste packages would incur additional dose to operators and financial cost to Sellafield Ltd and may also be

seen as a form of re-working. Furthermore, there is potential for incompatible wastes to be packed in the waste container which may jeopardise the integrity and performance of the container over time. RWMD recommends that a full data recording exercise is carried out at the point of retrieval. This would generate a complete set of package records to enable wasteform development studies to continue as well as giving stakeholders confidence in the performance of the as-stored waste packages.

Assessment of Disposability

The acceptability of the proposed packages has been assessed against criteria established for the Geological Disposal Concept and associated GWPS.

The Assessment of Disposability is based upon a set of radionuclide inventories derived by RWMD using a series of bounding assumptions of waste composition. Sellafield Ltd will be required to confirm the inventory of the MBGW during the retrievals process.

The assessments of transport safety show that it should be possible for packages containing MBGW to comply with all relevant criteria if transported in an IAEA Type B transport container with 285 mm thick steel walls, such as the Standard Waste Transport Container (SWTC-285).

The performance of waste packages under accident conditions is quantified as a set of Release Fractions (RF) that express the fraction of a package radionuclide inventory that could be released. The expected RF values for the packages containing MBGW have been evaluated through a comparison with existing data for generic and analogous waste packages to quantify the expected releases. For most waste streams, the analysis confirms that even under the most severe accident conditions affecting packages, doses to workers and the public would not approach significant levels.

The post-closure safety assessment has revealed no significant areas of concern that should prejudice disposal of packages containing MBGW.

In summary, the Assessment of Disposability has concluded that a Radioactive Waste Management Case ultimately could be made for packages containing MBGW on the basis of the assumptions used by RWMD in the assessments. It is expected that future assessment stages would enable the assumptions used in the assessments to be refined.

As noted above, the assessment of disposability was underpinned using data for analogous waste packages. This included the use of accident release fractions for a single skinned variant of the proposed 3m³ Box waste package. On the grounds that the assessment of disposability demonstrated that such a package should be disposable, RWMD does not necessarily recommend the use of the double-skinned variant package and carbon steel liner for this waste stream. However, it is recognised that there may be operational reasons behind the decision to employ the proposed multi-barrier approach for containerisation of the waste. In particular, passive safety will need to be demonstrated throughout the period of interim storage within the B243 Laydown Area.

Requirements for further development work

The Conceptual stage submission, and the resulting assessment by RWMD, has been based upon a number of outline proposals for the packaging of MBGW.

At the Conceptual stage, further work is required to support proposals for wasteforms derived from particulate wastes. Such work might involve the provision of small-scale grouting facilities at the point of retrieval, for example, by encapsulation in 200 litre drums using an in-drum mixing process. Another possibility might be the use of alternative waste conditioning plants already in existence on the Sellafield site, for example, the Wastes Encapsulation Plant (WEP).

The next submission stage is expected to occur prior to the commencement of retrieval of the MBGW from the eight concrete cells. At that time, RWMD will seek resolution of a number of issues before the proposals are endorsed to enable the wastes to be packed into the 3m³ Boxes for interim storage. These issues include:

- Positive confirmation that a waste conditioning exit strategy for the interim stored wastes will be available. It would not be possible to endorse the proposals at the next stage if there is any uncertainty that the wastes may be interim stored for an indefinite period or for greater than ten years.
- Development of detailed data recording proposals, including provision of a data recording methodology describing the packaging process and how data will be obtained and recorded.
- Definition of an outline waste composition envelope for packing.
- Proposals for treatment of wastes requiring additional treatment. This will include large items and particulate wastes.
- Evidence to demonstrate the effectiveness of low force compaction of HEPA filters.
- A determination of the quantity of aluminium in the MBGW and operational controls to restrict the mass of this material being consigned to any one package.
- Provision of detailed design proposals for the specific features of the MBGW container and inner liner.
- Evidence of operational controls to restrict the quantity of PVC being packed into each container.
- Development of criticality safety assessments or arguments to show compatibility with the generic criticality safety assessment for Irradiated Natural Uranium, and development of Criticality Compliance Assurance Documentation for the packed wastes.
- Development of the draft Waste Product Specification.

At the Interim stage RWMD would expect to see the details of packaging proposals developed and substantiated through the provision of evidence in the following areas:

- Provision of complete waste characterisation records for the contents of each MBGW package and definition of the waste stream envelope;
- Development of an appropriate wasteform formulation and demonstration that the proposed formulation is robust to all variations in the waste and process;
- Demonstration of the accident performance of MBGW packages. This will need to be derived from the specific features of the waste package including the container design and encapsulating medium.

Conclusions

The Conceptual stage packaging options proposed for MBGW from eight above ground storage cells have been assessed.

The proposals for general scrap and trash and HEPA filters are expected to be consistent with future requirements and can therefore be endorsed at the Conceptual stage. It should also be possible to co-package HEPA filters with the general scrap and trash wastes in any proportions, should there be an operational requirement to do so.

It has not been possible to endorse proposals for packing particulate wastes at this stage. The wasteform assessment has concluded that the proposals for packaging particulates would not be consistent with current specifications and that this could lead to unacceptable activity release in the event of impact accidents. Furthermore, there is a risk that free water could be associated with particulate materials and the effects of such liquids could be detrimental to package performance during interim storage and beyond. Sellafield Ltd will be required to provide more detailed proposals for the conditioning of particulate wastes.

A number of Action Points have also been raised which will require to be addressed as part of any future Letter of Compliance proposals for the MBGW.

The proposals to package MBGW have been judged against the regulatory guidance³ and the view of RWMD is that they be considered as MEDIUM priority for regulatory scrutiny. The principal reason for this judgement is due to the proposal to defer conditioning for up to ten years after packing the waste into disposal containers. In addition, there may be conflicts of interest between the regulatory driver to package the waste in short timescales and the need for proper characterisation that need to be considered by the regulators. Sellafield Ltd is advised to seek the necessary interaction with regulators to confirm this position.

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