

Highly Active Technical Wastes from Wastes Vitrification Plant, Sellafield (Pre-Conceptual stage)

Summary of Assessment Report

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Introduction

Highly Active Liquor (HAL) that has arisen as a function of fuel reprocessing operations at Sellafield is solidified into borosilicate glass products at the Wastes Vitrification Plant (WVP).

A number of secondary wastes are generated as a result of the operation of the three vitrification lines at WVP. Each vitrification line is routinely re-built to replace the melter and the calciner bearings and seals after about 4,000 hours of operation. Spent off-gas filters also arise from the pour off-gas treatment system in vitrification line 3.

Equipment which has been replaced is referred to as 'technical' waste and is treated in the WVP Breakdown Cell. Here, larger items are size reduced using cutting techniques. HA technical wastes are currently retained in the WVP Breakdown Cell and a significant stockpile has now accumulated. Sellafield Ltd has presented proposals to NDA Radioactive Waste Management Directorate (hereafter RWMD) for the packaging of the accumulated HA technical wastes, along with predicted future arisings.

The waste addressed by these proposals comprises largely of melter parts contaminated with HA product glass, extract filters from the pour off-gas system on vitrification Line 3, and loose calcine residues and swarf from cutting up of equipment in the HA Breakdown Cell. Three alternative options have been proposed for the management of melter parts contaminated with HA product glass, along with a single option for each of the extract filters and calcine/swarf residues. All five of the options involve placement of the HA technical wastes in stainless steel product canisters of the same envelope and dimensions as currently used to package vitrified HLW. Canister closure arrangements would have to be modified to allow larger items to be packaged in the standard envelope of the vitrified HLW product canisters.

This Assessment Report summarises the conclusions of the assessment by RWMD of the pre-conceptual stage submission by Sellafield Ltd for HA technical wastes. The assessment has been carried out through the Letter of Compliance process, whereby RWMD examines the disposability of proposals for waste packages by assessment against HLW packaging standards and specifications and the Reference HLW/spent fuel Concept. The 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 elsewhere.

Scope of the Proposals

The pre-conceptual stage assessment has considered the compatibility of the HA technical waste products with the requirements for safe long-term management,

including storage, transport, emplacement and disposal, as currently expressed in the Reference HLW/SF Concept .

This assessment addresses both the current stocks and future arisings of HA technical wastes from WVP. This is designated as waste stream 2F22/C in the National Inventory. The assessment has not considered the disposability of Medium Active (MA) technical wastes, since these are currently consigned to a separate facility as ILW.

Five alternative processing solutions have been considered in this assessment. The following three alternative options have been assessed for the processing of HA technical waste glass:

- Sectioned melter pieces containing large chunks of glass. Whole melter sections would be placed in single stainless steel canisters for storage and disposal;
- Fractured fragments of glass from the melters. Fractured glass would be tipped directly into a stainless steel canister; and
- Re-melted glass. Glass would be fragmented from the melters and returned to an operational melter for re-solidification into a glass monolith.

Single options have been proposed for each of the pour off-gas filters and calcine residue.

For pour off-gas filters, Sellafield Ltd has proposed direct placement inside a modified stainless steel canister, enabling four such filters to be packaged at one time.

Failed plant, such as rotary calciners, contain residual quantities of calcined HAL. This calcine is collected in small cans within the WVP Breakdown Cell along with metal swarf from cutting operations. Sellafield Ltd has proposed that the filled cans would be placed directly into a modified stainless steel canister, four cans at a time.

The assessment has assumed that there would be no encapsulating medium to infill the voidage in any of the packages.

Depending on which option is finally pursued by Sellafield Ltd, the total number of product canisters that could arise as a result of processing HA technical wastes should not exceed 140. This represents only a small fraction of the total number of HLW canisters destined for disposal in the GDF, which is predicted to be no more than 8,000 canisters in total.

The disposability of five proposed package variants has been considered by RWMD against the baseline Reference HLW/SF Concept. The baseline disposal package consists of a robust copper disposal overpack with a cast iron insert containing two product canisters.

The following alternative final packaging solutions have also been considered as part of this assessment as potential opportunities for future optimisation:

- Disposal of a larger copper disposal overpack containing three product canisters;
- Disposal of two or three canisters in a variant overpack constructed from mild steel; and
- Direct disposal of bare canisters with no additional protection such as a disposal overpack.

Although the HA technical waste represents only a small proportion of the total HLW stream, the proposals are considered as 'HIGH' priority under the current regulatory prioritisation scheme . This is due to the fact that the disposal of these wastes raises issues which are outside of previous RWMD experience. Furthermore, since RWMD

is not yet in a position to endorse any proposals for packaging HLW products, the regulators may wish to understand the risks associated with packaging HA technical wastes for disposal. Sellafield Ltd may wish to use the information set out in this Assessment Report to support a case to enable hazard reduction work in the WVP Breakdown Cells in advance of the receipt of a Letter of Compliance. For these reasons, this Assessment Report will also be referred to RWMD's Nuclear Safety and Environment Committee (NSEC). The conclusions of the Assessment Report are therefore conditional, pending comment from the NSEC.

Technical Issues

For the glass options, re-melting of the glass is likely to be advantageous due to the potential for reducing the overall number of packages that would need to be consigned for disposal. However, this option would not provide a solution for all HA technical glass without significant modification to the plant and process at WVP. For this reason, re-melting is considered to be only a partial solution for HA technical glass, and alternative solutions would need to be adopted to ensure that all of the HA technical waste glass could be adequately managed.

Sectioning of melter pieces appears to be a pragmatic solution. Sellafield Ltd would need to demonstrate that the melter sections could be adequately packaged using a modified variant stainless steel canister and associated furniture.

Disposal of fractured glass is potentially problematic due to the presence of significant quantities of glass fines that, depending on the final packaging solution, could be difficult to retain under impact accident conditions. The larger surface area of fractured glass could also lead to accelerated degradation of the glass in a disposal environment, relative to more monolithic glass wasteforms. The significance of this issue would need to be considered if Sellafield Ltd wishes to pursue this option.

Pour off-gas filters are expected to contain a potentially significant inventory of mobile radionuclides in the form of a dispersible dust. Therefore, like fractured glass, there is again potential for undesirable wasteform performance under accident conditions. Depending upon the final packaging solution, Sellafield Ltd may be required to provide more advanced proposals for a suitable wasteform for this stream.

Disposal of raw calcine presents a number of potentially significant challenges. The potential for gas generation as a result of thermal decomposition of residual nitrate contained in this waste could threaten transport, operational and post-closure safety cases. Furthermore, on contact with water, the potential for generation of acidic liquor has been identified. Acidification could compromise the performance of the engineered barriers of the disposal concept. If Sellafield Ltd wishes to dispose of calcine as HA technical waste, then there is a need to better characterise this material. Furthermore, a more stable wasteform would also need to be developed for this stream, particularly if alternative disposal concepts are to be explored in the future.

Assessment of Disposability

This pre-conceptual stage assessment has considered the disposability of HA technical waste against criteria established for the Reference HLW/spent fuel Concept for geological disposal and the associated preliminary Waste Package Specification (WPS). This includes transport of the waste packages to the GDF, transfer and emplacement operations at the GDF and the period following backfilling and closure of the facility.

The assessment indicates that, with a little more development work, it should be feasible to make a disposability safety case for the baseline disposal package (copper overpack containing two product canisters).

The assessment has also shown that, provided a robust disposal overpack is employed, and other generic issues are resolved, there should be no reason why it would not be appropriate to exploit the alternative disposal overpacks identified above. The larger copper overpack would reduce the total number of disposal packages and hence transport risk, as well as capital cost. A mild steel overpack would also be expected to provide the necessary performance requirements but at a lower capital cost than copper.

There are a number of reasons why it might be desirable to also consider disposal of bare packages, without any form of overpack. The assessment has shown that it may be possible to demonstrate that such canisters could constitute a disposal package in their own right. However, a number of additional uncertainties would need to be resolved if this opportunity were to be exploited. In particular, the packages would be less well protected. For this reason, based on the current proposals, the assessment found that transport and handling risks are currently unacceptable. In spite of this, simple enhancement of the wasteforms and container design could make direct disposal a feasible option.

Future Development Work

None of the proposed processing and packaging options are precluded from endorsement at this time. Specific actions that necessarily need to be resolved to enable the proposed packages to be endorsed via the issue of a Letter of Compliance are set out in this Assessment Report.

RWMD is not currently in a position to endorse the proposals since the HLW disposal concept is not fully developed at this time. RWMD may reconsider this position later in 2010 following the publication of the Disposal System Safety Case (DSSC).