

Sellafield Wastes Encapsulation Plant (Periodic Review)

Summary of Assessment Report

Issue date of Assessment Report: 18 January 2008

Background

The Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA) provides an assessment service for Site License Companies with respect to proposals for packaging waste against the requirements of the Phased Geological Repository Concept. This is the Letter of Compliance (LoC) assessment process. Full endorsement of such proposals is signified by the issue of a 'Final stage LoC'. The Final Stage LoC typically forms a component of a Site License Company's Radioactive Waste Management Case, which is expected to be prepared to obtain regulatory approval for implementation of the packaging proposal and manufacture actual waste packages.

The issue of a Final stage LoC by NDA indicates that waste packages manufactured in accordance with a proposed process, will be disposable when judged against the requirements of the Phased Geological Repository Concept. The LoC also provides a key component of the package record that will be needed for interactions with the disposal facility operator at the time of disposal. However, the issue of a Final stage LoC is not a one-off event but rather an initial step in the process of the long-term management of a particular radioactive waste. Maintenance of the continued validity of the LoC is therefore an essential component of the strategy for managing the risks that waste packages will not be accepted into future disposal facilities such as a national geological repository.

Following issue of the Final stage Letter of Compliance (LoC) and on receipt of regulatory licence permissions, it is anticipated that the waste packager will manufacture waste packages in accordance with the endorsed proposals and to an agreed Waste Product Specification. Though the Final Stage LoC is not necessarily required before the regulators will accept a Radioactive Waste Management Case, the LoC is considered to be the most appropriate means for demonstrating that waste packages will be compliant with the onward phases of waste management.

It has been the expectation that the currency of Final stage LoCs would be reviewed periodically. The periodic review provides the means for ensuring the continued validity of Final stage LoCs over the extended period from endorsement of a packaging proposal to the time when waste packages are consigned for disposal. Typically, periodic reviews would be undertaken at ten-yearly intervals to ensure that the Final stage LoC remains up to date and consistent with potentially evolving safety and environmental assessments.

In 1993, a Final stage LoC was issued for the packaging of wastes within the Wastes Encapsulation Plant (WEP) at Sellafield. Since that time, BNFL, and more recently the SLC, Sellafield Ltd, has been operating WEP under this LoC to package wastes arising from the Thermal Oxide Reprocessing Plant (THORP). A total of 6,240 waste packages have been manufactured at WEP up to April 2007.

The 1993 LoC was subject to a number of conditions, a number of which still remain to be resolved by Sellafield Ltd at December 2007. Furthermore, since the original LoC was issued in 1993, the regulatory arrangements for conditioning of radioactive wastes on

Nuclear Licensed Sites have evolved. The revised arrangements include the requirement to undertake an assessment of disposability to demonstrate that waste packages are compatible with regulatory requirements and the Phased Geological Repository Concept. On these grounds and as a result of further direction from the regulators, it has been agreed that the Final stage LoC covering WEP should be subject to periodic review.

This Assessment Report summarises the conclusions of the WEP LoC periodic review by NDA RWMD. This is the first periodic review to be undertaken by NDA Radioactive Waste Management Directorate.

Packaging Process

WEP receives the wastes arising from reprocessing operations at THORP. There are four main categories of waste arising from THORP operations, which are consigned to WEP for processing and encapsulation:

- Sheared and leached sections of metallic fuel cladding materials, plus fuel element structural end appendages known as ‘hulls and ends’;
- Slurry separated from dissolver liquor by centrifuge, containing fine insoluble fission product particles and sludge. This is known as centrifuge cake;
- Alkaline slurry containing barium carbonate precipitate from the dissolver off-gas system and fine corrosion product particles from the fuel cladding. This is referred to as barium carbonate/Multi-Element Bottle (MEB) crud; and
- Items of steel scrap derived from remote handling operations at both THORP and WEP, known as THORP/WEP scrap.

At WEP, there are two processing lines for the transfer of these wastes to stainless steel 500 litre drums for conditioning in a cementitious grout matrix. Hulls and ends and THORP/WEP scrap are transferred to drums for direct grouting. Slurries (centrifuge cake and barium carbonate/MEB crud) are in-drum mixed with cement powders using a ‘lost-paddle’ arrangement to produce a homogeneous conditioned matrix. Once the grout is cured, the drums are transferred to safe interim on-site storage in a stillage, each containing four product drums.

Further categories of waste, general effluent washings and nitric acid decontamination liquors, were also endorsed in the 1993 Final stage LoC. Since then there have been no arisings of these wastes requiring encapsulation in WEP. These have therefore not been subject to detailed scrutiny as part of this periodic review.

Scope of the Periodic Review

This periodic review considers the following key issues:

- Evolution of the RWMD disposability safety assessments and applicability to WEP wastes;
- Status of conditions, restrictions and caveats as applied to the current endorsements;
- Actual plant performance relative to the endorsed process;
- Closure of plants and preservation of manufacturing records;
- Condition of stored packages;
- Status of facility Quality Management Systems;
- Assessment of new wastes that have not been subject to previous evaluation.

This review has generally followed the approach described in NDA RWMD guidance¹.

¹ Waste Package Specification and Guidance Document, *Guidance on the Scope of Periodic Review of Final Stage Letters of Compliance*, WPS/909, October 2007

Assessment

Evolution of Disposability Safety Assessment

The disposability of WEP wastes has been assessed against the current safety and environmental assessments supporting the geological disposal concept. This includes packages manufactured to date, packages that could be manufactured at the limits of the current endorsement, and also packages manufactured from proposed future wastes that are expected to arise as a result of reprocessing new or variant fuels through THORP.

The assessment of disposability has demonstrated that:

- Packages manufactured to date should be compatible with the requirements for interim storage, transport, handling and disposal as encompassed by the Phased Geological Repository Concept. This does not include packages declared to be non-conforming or non-standard; such packages will require to be subject to assessment on an individual basis;
- Packages manufactured at, or near to, the currently defined waste package upper activity limits have been shown not to be compliant with disposability criteria using current models and data. To date, WEP packages have not been produced at the assessed limit, although the current endorsement does not preclude this situation. This has brought into question the basis for the current limits and Sellafield Ltd will be required to work with NDA RWMD to identify more appropriate limits based on disposability attributes. Conversely, it might be possible to make a case for disposal through a detailed review of the criteria used in the assessments of disposability. Notwithstanding such reviews, it has been recognised that any future restrictions on regulatory limits for Design Basis Accidents could further jeopardise the disposability of such packages;
- The assessment of packages derived from new fuels, such as those derived from higher burn-up uranium oxide and Mixed Oxide (MOX), has also shown that such wastes may not be disposable. This is based on NDA's current understanding of such wastes. On these grounds, Sellafield Ltd will need to make a specific, more detailed submission to enable NDA to make robust disposability arguments for any wastes that could be generated by the reprocessing of these fuels. This should ideally be undertaken on a case-by-case basis to account for the variability in the nature of different fuel types.

Conditions, Restrictions and Caveats

A number of conditions, restrictions and caveats were attached to the early LoCs for WEP. NDA RWMD and Sellafield Ltd are working together to ensure that all of these are closed out. This periodic review has evaluated the status of these issues, which have more recently been converted into specific Action Points for tracking purposes. A total of seventeen historic Action Points have been evaluated.

Sellafield Ltd has progressed resolution of a number of these issues, enabling eight of the outstanding Action Points to be closed out. Advice has been offered to enable timely resolution of the remaining nine Action Points. Particular effort needs to be directed at resolution of a number of long-standing data recording issues.

Actual Plant Performance

A review of actual WEP package performance has been undertaken in relation to the endorsed proposals. This has shown that instances of non-compliance against the Waste Product Specification (WPrS) are low (0.8% of total packages to date) with apparent year-on-year improvements in performance. The instances of non-standard packages arising is also low (1.4% of total packages to date) and again, this figure appears to be improving. This

suggests that WEP is generally performing as anticipated and demonstrates a good commitment to product quality.

Sellafield Ltd is advised to work with NDA RWMD to establish specific arrangements for future management and disposition of non-standard/non-compliant packages.

It would typically be expected at the periodic review stage that information from waste package inspections should be available to confirm that stored packages are performing as intended. To date, no such inspections have been undertaken for WEP packages and it has therefore not been possible to establish that the packages are evolving as envisaged. It is recommended that inspections of stored packages are undertaken and the information reported to NDA RWMD to complete this aspect of the review.

Closure of Plants and Preservation of Manufacturing Records

A number of recent audits of THORP/WEP have identified weaknesses in records management. Consequently, WEP package records have been reviewed in terms of content, physical format and long-term storage arrangements against current guidance. Sellafield Ltd has provided some limited further information that demonstrates that records management plans are being put into place across the Sellafield site, although specific plans need to be made more coherent.

Advice has been given on the structure and format of package records. This includes not just individual drum records, but also the other features that comprise the total package record, including drawings, specifications, radionuclide inventories and so on. Further advice is available from NDA as required.

NDA RWMD will seek to undertake future QMS audits on Sellafield packaging plants, which will include a focus on records management to ensure that this important issue is given sufficient attention.

Status of Quality Management System

An overview of the status of QMS audits at WEP has been undertaken to ensure that there are no long-standing issues requiring resolution. Key documentation, including plant Conditions for Acceptance, has also been reviewed for compatibility against the WPrS.

Some progress is apparent in respect of audit findings, for example, the production of revised WPrS documents and CCADs, both of which have been reviewed as part of this periodic review. Notwithstanding this progress, a number of audit findings, which re-iterate the need for closure of long-standing Action Points and the generation and storage of package records, have yet to be resolved. As noted above, NDA RWMD will seek to undertake future QMS audits at Sellafield to review the status of these specific issues.

New Wastes

As noted above, WEP wastes generated from the reprocessing of new Mixed Oxide (MOX) and variant high burn-up uranium (HBU) fuels through THORP have been assessed in terms of compatibility with the current endorsement and in terms of disposability. Further work is required to demonstrate that such fuels would not threaten the future disposability of the derived WEP waste packages.

It is understood that Sellafield Ltd has already started to reprocess higher burn-up uranium oxide fuels through THORP. Indeed, the need to consider increasing burn-ups of uranium in oxide fuels and its implications on disposability of WEP wastes came about as a result of the finding of a regulatory audit, which identified an increasing trend of reprocessing higher burn-up fuels at THORP. It is therefore imperative that Sellafield Ltd works with NDA RWMD to develop suitable package limits and disposability arguments to support the manufacture of wastes from this source.

Specific high burn-up fuels have also been identified as posing individual threats to package disposability and any submission would be required to provide a bounding case for all potential waste permutations. Similarly, an individual case needs to be made for MOX-derived wastes due to specific issues arising from the presence of insoluble plutonium oxides.

Conclusions

The main conclusions of this periodic review are that:

- The Wastes Encapsulation Plant is performing within its design intent;
- It should be possible to make a robust disposability case for waste packages manufactured at WEP to date;
- It has not been possible to make a disposability case for waste packages that could be manufactured at or near to the limits of the current endorsement. Related to this, it will be necessary to re-evaluate the basis for the currently defined waste package activity limits;
- It has not been possible to make a disposability case for waste packages that could be produced as a result of reprocessing MOX and HBU fuels through THORP. More detailed proposals will require to be made before any endorsement may be given for the manufacture of such packages;
- Further work is required to close out certain long-standing Action Points. Advice has been provided on how these issues might be resolved.

On the basis of the above points, it is concluded that the endorsement for WEP wastes remains unchanged at this time, with the following wastes being included as part of that endorsement:

- Hulls and ends derived from AGR and LWR fuels;
- Centrifuge cake;
- Barium carbonate/MEB crud, including the ion exchange materials Co-Treat, Cs-Treat and clinoptilolite; and
- Scrap arising from operations within THORP and WEP.

Packages that are deemed by Sellafield Ltd to be non-conforming or non-standard are precluded from endorsement at this point in time. Sellafield Ltd will be required to submit separate proposals to enable a disposability case to be generated for these packages.

Whilst the current endorsement enables the production of packages with radionuclide activities up to the limits defined in the ILW Residues Specification, Sellafield Ltd is advised to avoid this situation until further consultation with NDA RWMD has confirmed a more appropriate set of limits related to disposability criteria.

Wastes derived from the reprocessing of MOX and HBU fuels remain outside the scope of the current endorsement.

It would be expected that the boundaries of the endorsement will be modified as further work is undertaken to address the new Action Points raised within this periodic review.