

Packaging Options for B29 LETP IONSIV Cartridges (Conceptual stage)

Summary of Assessment Report

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Background

British Nuclear Group Sellafield Ltd (BNGSL) has sought Conceptual stage endorsement for the packaging of 'IONSIV' ion exchange media arising from the operation of a Liquid Effluent Treatment Plant (LETP) in the Original Fuel Storage Pond at Sellafield. The LETP will be used to control activity levels in the pond and will generate spent IONSIV media as a waste product.

This document summarises the results of the assessment carried out by Nirex in response to the submitted proposals to package IONSIV wastes. The assessment has been carried-out as part of the Letter of Compliance process, whereby Nirex examines the disposability of the proposed waste packages by assessment against ILW packaging standards and specifications and the underpinning Phased Geological Repository Concept (PGRC). Further information on the Letter of Compliance process is available elsewhere¹.

A Conceptual stage disposability assessment has been conducted and this Assessment Report produced.

It should be noted that Conceptual stage endorsement is sought for the LETP IONSIV wastes prior to these wastes actually being generated. This is a unique position given that Letters of Compliance are normally sought for wastes that already exist. This position is welcomed by Nirex as this provides an opportunity for early dialogue with the waste producer and gives confidence that a management route is available before the material is used and wastes generated. Such an approach will ensure that robust waste package records are generated, thus eliminating uncertainties that are often encountered as a result of the need for retrospective waste characterisation. The data recording aspects of the Original Fuel Storage Pond LETP operations are therefore fundamental to ensuring that appropriate information is gathered at the time at which the waste is generated. Early dialogue between Nirex and BNGSL has taken place to develop a detailed data recording methodology for the LETP. Nirex is satisfied that the plans that have been put into place will ensure that suitable waste records will be generated at the time of arising and that these records will be appropriate for generating eventual package records.

Scope of the Proposals

The Original Fuel Storage Pond is a facility on Sellafield site that was in use for a period of some fifty years for the storage of fuel from a number of reactors, including the Windscale Piles and Calder Hall power station. Over the years, a layer of mobile sludge has formed over the floor of the pond, comprised predominantly of the corrosion products of fuel elements and pond furniture and wind-blown sand, along with organic matter, generated from the presence of bird droppings, wind-blown leaf debris and algae in the pond water. The sludge is to be retrieved from the pond floor for solidification in a local sludge treatment plant,

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

and this retrieval process is expected to result in an increase in radioactivity levels within the pond as a result of re-suspension of radionuclides contained in the sludge. The LETP will be used to treat the pond water, both to reduce the dose to operators working on the pond and to control downstream discharges to the Segregated Effluent Treatment Plant (SETP). The LETP will use a sand bed filter to remove any suspended solids, and IONSIV cartridges to remove mainly dissolved caesium and strontium isotopes from the pond water.

This Assessment Report examines the disposability of the IONSIV cartridges against the requirements of the Nirex PGRC and associated packaging standards.

Spent cartridges will be removed from the LETP and returned to the Original Fuel Storage Pond until the end of LETP operations, currently predicted to be up to ten years. Between 54 and 116 cartridges are expected to arise during this period of operation.

BNGSL has submitted two alternative options for the processing of the spent IONSIV cartridges:

- Transfer the cartridges in a shielded flask to the Box Encapsulation Plant (BEP) for processing;
- Process the cartridges using a mobile plant adjacent to the Original Fuel Storage Pond.

In both options, the IONSIV cartridges would be infiltrated with a polymer encapsulating media to immobilise the IONSIV beads. The two processing routes would lead to two different waste packages. The packages from BEP would consist of IONSIV cartridges encapsulated in polymer within a cartridge liner, with between 5 and 7 of these liners placed in a 3m³ stainless steel box and the void spaces in the box would then be infilled with a cementitious grout. The packages from the mobile plant would consist of IONSIV cartridges directly encapsulated in polymer within shielded 500 litre stainless steel drums.

The total number of packages produced is dependent upon a number of factors including, the effectiveness of the IONSIV material in removing activity from the pond; the processing option selected; and, in the case of the BEP option, the number of cartridge liners that can be physically accommodated within each 3m³ Box. Completed packages would be stored within an (as yet) undisclosed on-site store until a suitable disposal route becomes available.

The proposed packaging process is expected to result in the production of up to 10 off 3m³ Boxes, each containing multiple IONSIV cartridges, or 54 off 500 litre Drums, each containing single cartridges. This is based on the best current estimate of 54 cartridges arising during LETP operations, although this could be as high as 116 cartridges. When compared to a geological disposal reference case conditioned volume of Unshielded ILW (UILW) of 152,000 m³, the IONSIV cartridges would constitute 0.01% of the volume of the UILW waste considered in the Phased Geological Repository Concept.

Assessment of Disposability

The disposability assessment conducted by Nirex considers the proposed waste packages for compliance with the Phased Geological Repository Concept (PGRC). This is achieved by assessing the proposed waste packages against published generic safety assessments that address transport of waste packages to the facility and safety of operations at the facility. The wastes and packages are also assessed against the generic post-closure performance assessment.

The Assessment of Disposability is based upon the inventory data supplied by BNGSL, which has been derived from the assumed in-service performance of the IONSIV in the Original Fuel Storage Pond. In order to provide a bounded assessment of disposability, both best estimate and bounding package inventories have been defined and used in the assessment process.

Both packaging options are demonstrated to be consistent with the requirements of the Nirex Generic Waste Package Specification (GWPS) and have been judged to follow established good practice. Nonetheless, there are a number of lines of evidence which favour the 3m³ Box option, including minimisation of the total number of packages produced, the material usage, and transport requirements. Furthermore, the use of the existing BEP plant for the packaging of the Boxes is seen as a benefit as it would not then be necessary to build a separate plant as would be the case for the 500 litre Drum. It is expected that BNGSL would provide further consideration of the merits of the two options in defining the actual adopted packaging process.

The assessment of Transport Safety showed that it should be possible for both 500 litre Drums, and 3m³ Boxes containing the IONSIV cartridges to comply with all relevant transport safety criteria if transported in a Type B transport container with 285mm thick walls, such as the SWTC-285.

Similarly, the assessments of Operational Safety showed that it should be possible for both 500 litre Drums, and 3m³ Boxes containing the IONSIV cartridges to be handled and stored safely within a repository based on the PGRC.

The post-closure safety assessment revealed no significant areas of concern that should prejudice disposal of packages containing the IONSIV cartridges. Future work is being undertaken by Nirex to more fully establish the long-term performance of the polymers that are proposed for use as encapsulating materials. These polymers are typically relatively stable thermosetting that have demonstrated good resistance to degradation and therefore are not expected to challenge the assumptions made in the PGRC. This position is judged to be sufficient to endorse the use of the material at the Conceptual Stage despite any uncertainty in long-term stability, particularly when weighed against the advantages of good infiltration and protection of the waste.

In summary, the Assessment of Disposability has concluded that a Disposability Safety Case ultimately could be made for packages containing the IONSIV cartridges, and that the proposals for the packaging of these wastes can be endorsed at the Conceptual stage. During the course of the assessment, areas requiring additional work to progress the proposals beyond the Conceptual stage were identified, and these are summarised below.

Requirements for Further Work

During the course of the assessment, a number of technical issues were identified as requiring resolution prior to the proposals being endorsed at the Conceptual stage and the IONSIV cartridges entering service. These issues were highlighted to BNGSL in the form of an interim response which flagged the need for improved information relating to the derivation of radionuclide inventory for the waste and data recording. These issues have been addressed by BNGSL providing confidence in the predictions of arisings of spent cartridges and that operation of the LETP will be conducted in such a way that suitable waste package records will eventually be generated at the time of packaging.

A number of further outstanding technical issues have been identified for as requiring resolution prior to the proposals being endorsed at Interim stage. These Action Points relate to:

- details of the proposed polymer formulation;
- confirmation of the proposed cementitious grout formulation and information regarding key product parameters;
- the provision of complete drawings and design specifications for the proposed waste package container design, including details of ventilation, surface finish and container furniture;
- the provision of details of the proposed waste package storage environment; and

- provision of draft Waste Product Specification and Criticality Compliance Assurance documents.

The identification of these key characteristics provides a focus for development work, with the design, demonstration and justification of the polymer infiltration being the principal requirement. It is further noted that any such development would need to be based on a suitable simulant of the waste that takes due account of any ageing effects that might occur during operations and storage prior to final packaging.

Conclusions

A Conceptual stage assessment of BNGSL's proposals for packaging of IONSIV cartridges from the operation of the original fuel storage pond LETP has determined that the cartridges should be compatible with the PGRC. Consequently, Nirex is able to endorse the proposed packaging of original fuel storage pond IONSIV cartridges at the Conceptual stage through the issue of a Letter of Compliance.