

Packaging of Processing Plant ILW at Chapelcross (Interim Stage)

Summary of Assessment Report

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EXECUTIVE SUMMARY

Background

Radioactive Waste Management Limited (hereafter RWM) has undertaken an Interim stage Disposability Assessment for the proposals from Magnox for the packaging of ILW arising from the decommissioning of the Chapelcross Processing Plant (CXPP) at the Chapelcross Site.

A fraction of the wastes are currently packed in Temporary Storage Vessels (subsequently called TSVs). It is further proposed that the wastes currently packed into TSVs would be overpacked into stainless steel drums (subsequently called TSV overpacks) while the remainder of the waste would be retrieved and packed into annular 500 litre drums. The non-vented annular 500 litre drums and TSV overpacks would then be placed into interim storage in accordance with Scottish Policy.

In order to provide a basis for disposability assessment, it is assumed that, at an appropriate stage in the future, the TSV overpacks would be retrofitted with vents and along with the sealed annular 500 litre drums would be packaged into vented 4 metre stainless steel boxes for geological disposal. It is recognised that, at this time, it would not be planned to implement this element of the proposals.

The objectives of this Interim stage assessment of proposals for packages of Processing Plant ILW are to provide Magnox with:

- an assessment of disposability in accordance with the Joint Regulators' Guidance to Industry
- supporting advice on disposability of CXPP ILW to Magnox in the form of an Assessment Report
- where appropriate, endorsement of the proposals via issue of a Letter of Compliance (LoC).

Further information on the Disposability Assessment process is available elsewhere¹.

The packaging of some CXPP wastes in Ductile Cast Iron Containers (DCICs) received Conceptual stage LoC endorsement in 2012. The current packaging proposals are not covered by the endorsement.

¹NDA, *An Overview of the RWM Disposability Assessment Process*, WPS/650/03, April 2014.

RWM Reference Basis for Assessment and Endorsement

The Disposability Assessment process considers the compatibility of the proposed packages with the requirements for safe long-term management, including interim storage at the site of arising, transport, emplacement and potentially extended storage underground, and disposal. The current reference basis for such an assessment is the documented disposal system concept and safety case for a Geological Disposal Facility (GDF) derived from the generic Disposal System Safety Case (DSSC).

The general requirements placed on waste packages for disposal in a GDF are embodied in the Disposal System Specification. Further requirements for particular types of waste package are embodied in the relevant Waste Package Specification (WPS). In the case of the CXPP ILW waste packages, the relevant WPS is that for packages based on the 4 metre box waste container.

Scope of the Assessment

The current proposals for the packaging of CXPP ILW are based on the initial 'packing' stage to produce packages suitable for interim storage (500 litre drums and TSVs), with the recognition that a subsequent 'packaging' stage would be required to finalise the proposed disposal packages (packages based on 4 metre boxes).

The reported assessment has primarily considered the disposal packages and has recognised the storage packages as 'interim products' that would be precursors to the production of the disposal packages. Furthermore, to fully understand the requirements that should be placed on the production of the storage packages, especially those relating to the provision of data and information that ultimately would be required for disposal, it is necessary to apply a sufficient understanding of the final disposal packages.

The assessment has also responded to a number of specific queries raised by Magnox, seeking guidance on further development necessary to support progress to later stages of endorsement.

Packaging Process

Nature of the Waste

CXPP operated from 1980 to 2005 for the production of tritium for the UK Government. Tritium was produced through neutron irradiation of Pippa Isotope Cartridges (PICs) containing lithium-bearing ceramic pellets. The tritium rich PIC's following irradiation were then processed within CXPP to liberate the tritium, purify the tritium and store it in containers for transport off site.

The wastes arising from decommissioning of CXPP consist of a variety of materials including (with associated 2016 RWI identifiers):

- ceramic pellets (2C06) - lithium aluminate and clay binder ceramic pellets which were then heated in the Extraction Cave for 11h at 1000 °C to liberate tritium. The liberated ceramic pellets are currently stored in stainless steel bottles.
- Cave Line wastes (2C07, 2C29) - operational waste and plant components from decommissioning of the Breakdown and Extraction Cave in CXPP.

- Process Line wastes (2C30) - depleted uranium beds (and associated pipework and vessels) used to purify the recovered tritium.
- rotary pump oil (2C15) – oil used with rotary pumps in CXPP. Now stored in stainless steel bottles, some with absorbent.
- spark arrestors (2C34) - steel frame with fibreglass mesh filters used in the ventilation in the Cave Line and decontamination hall to prevent ignition of high energy particular air (HEPA) filters.
- CEGB cartridges (2C32) - mild steel components used to hold specimens for Charpy fracture testing.
- product containers (2C36) - stainless steel containers used to store and transfer tritium.
- Care and Maintenance Preparation (2C926) - structural concrete and metal from the clean out of CXPP (note that 2C926 is not included with the 2016 UKRWI. This is an error in the RWI).
- Santovac 5 - a very high viscosity, synthetic (polyphenyl ether) fluid that is present within four diffusion pumps.

Based on the above, the CXPP ILW for packaging comprises a range of primarily solid wastes (with some liquid oil and mercury). A number of minor materials are also present in the waste including vermiculite (and other absorbents), mercury (liquid and amalgam with gold), palladium, silica, copper and fibreglass.

The total volume of conditioned waste is estimated to be approximately 621 m³.

Waste Processing and Packaging

The proposals for waste package production are based on common practice for the immobilisation of solid wastes namely encapsulation into a 4 metre box using a fluid cementitious grout. This approach is designed to make the wastes passively safe while avoiding the need for future repackaging.

The design of the 4 metre box waste container is based on that developed by Nirex in the 1990s to early 2000s. This container has an associated Waste Package Specification (WPS) and contents specification, and is considered by RWM to represent 'sound engineering' best practice and was designed to meet the requirements of the transport and GDF systems.

The wastes within the annular 500 litre drums and TSV overpacks will not be immobilised. The annulus 500 litre drum will not contain cementitious grout (is assumed to be empty) and the lid of the drum will be welded to provide containment of tritium whilst the TSV overpack will be retrofitted with a vent prior to placing into a 4 metre box.

The CXPP ILW in 4 metre box waste packages are not expected to require any interim storage as they will be packaged immediately before transport to a GDF, should it be required.

Assessment Inventory and Number of Packages

Following review of the submission and supporting information, the total waste stream assessment inventory has been based on the estimated masses of various components and individual mass-scaled activities and fingerprints for the different waste streams, which have been derived from sampling,

activation calculations and use of the RWM generic fuel inventory spreadsheet.

The assessment inventories directly use the mass-scaled activities and fingerprints, as supplied by Magnox, for most of the waste volume. For the ceramic pellets the submitted data have been modified to address minor inconsistencies. A commitment to further development of these activities and fingerprints within the submission is also recognised and advice has been provided in this assessment.

The average assessment inventory has been derived by division of the total assessment inventory by the assumed number of packages. The maximum assessment inventory has been derived as an unrealistic composite that contains all of the greatest contributors to dose rate; CEGB cartridges (expected to be disposed of in a single 500 litre drum) plus the radionuclide inventory of the most highly tritium-contaminated waste.

The packaging of CXPP ILW is assumed to give rise to 57 waste packages.

Assessment of Disposability

Waste Package Properties and Performance

The proposed CXPP ILW in 4 metre box wasteform essentially comprises storage packages encapsulated in a cementitious grout. Although the grout formulation has not been fully developed, it is assumed by Magnox that it would be based on a relatively standard mix of blast furnace slag and Portland cement (BFS/OPC). Such a formulation would be expected to provide the necessary properties and performance.

The proposed packages include sealed 500 litre drums, which would not be expected to produce significant quantities of bulk gases. The vented TSV overpacks may give rise to a moderate quantity of bulk gas, estimated as a maximum of 0.56 m³/year. These quantities of gas are not expected to give rise to significant challenges to the performance of the waste packages. Radioactive gas generation is dominated by tritium releases, either through the vents (for TSVs) or by diffusion from sealed drums. The assessed rates are consistent with acceptable performance, although further justification of these rates is required.

The multiple levels of containment offered by the disposal packages would be expected to provide suitable impact accident performance. The fire accident performance, particularly tritium containment under fire conditions, has been represented in a conservative manner to assess the necessary package performance. It is expected that significant containment would be available, but this remains to be demonstrated.

Compliance with the Transport System Design and Safety Case

Overall, RWM has sufficient confidence that the CXPP ILW in 4 metre box waste packages would be compliant with the transport system design and safety case as currently foreseen. The principal challenge is the potential for tritium release during normal conditions of transport. Although current assessed release rates are acceptable, further substantiation of the assumed rates is required.

The CXPP ILW is judged to be consistent with transport in a non-fissile transport package.

Notwithstanding the above, the proposals are not consistent with the current contents specification for packages based on the 4 metre box, due to the presence of free oil. Ultimately this may be addressed through an update to the specification, but at this time the packaging of free oils is excluded from endorsement.

Compliance with Engineering Design and the Operational Safety Case

The initial analysis of operational safety for the CXPP ILW in 4 metre box waste packages suggests that the assessed dose that workers in some fire accident scenarios may be significant. In practice, this arises from the very conservative treatment of the releases of gaseous radionuclides and in particular the application of an RF value of unity. The remaining assessed doses are consistent with RWM requirements.

RWM recognises the conservatism in the use of a fire RF of unity and that further work could be carried out to reduce this value such that it would result in the waste packages being demonstrably compliant with the disposal system Operational Safety Case.

Compliance with the Environmental Safety Case

RWM considers that the CXPP ILW waste packages would be largely compliant with the disposal system environmental safety requirements as currently foreseen. The environmental releases during operations are dominated by the assessed tritium releases. The tritium releases are acceptable, although relatively large. It is noted that further justification of the assessed releases has been sought.

The packing of the CXPP ILW into the storage packages in an un-encapsulated form introduces voidage into the waste packages. This is assessed to be in excess of the screening level of 5% developed by RWM and therefore further justification of the proposals is required to support this position. Conversely, RWM may seek further reduction in the voidage through, for example, infilling of the storage packages.

RWM has also identified risks relating to the presence of a moderate amount of mercury in the CXPP ILW. RWM is continuing to develop its understanding of the arguments relating to the significance of mercury as a hazardous pollutant.

Status of Management System and Data Recording

Magnox has provided limited proposals for waste package records and information production. Typically, at Interim stage RWM expects to be provided with drafts of the primary data recording system documents, such as a Data Recording Methodology statement (DRMS) and a Package Record Specification (PRS), as well as any Management System arrangements relating to data recording. Furthermore, the wider arrangements for managing the information and integrating this into records for future retention have not been developed at this time.

The lack of provision of the appropriate documentation on waste package records means that the proposals are not compliant with the requirements as

currently specified and Compliance Gaps have been identified accordingly. It is further noted that much of the required developments are likely to be required to support interim storage of the wastes.

The necessary state of development of the Management System arrangements potentially reflects the understanding that the disposal packages would not be produced until a later stage, immediately prior to transport for disposal. RWM accepts that this is appropriate. However, the arrangements governing the production of the storage packages are required at this stage, primarily to ensure that all relevant records are generated. This position has been recognised through a number of Compliance Gaps.

Notwithstanding the absence of required documentation, RWM considers that systematic and appropriate application of the Magnox Company Standards ultimately would meet the requirements for management system arrangements. This is considered sufficient to support endorsement of the proposed packages at the Conceptual stage.

Conclusions of Assessment of Disposability

It is concluded that the proposed waste packages are not consistent with RWM requirements as currently foreseen to enable Interim stage endorsement. Nevertheless, in undertaking the assessment, RWM has judged that the proposals would fulfil expectations for endorsement at the Conceptual stage.

Requirements for Further Work

Noting that the proposed waste packages are not consistent with RWM requirements for Interim stage endorsement, 14 Action Points have been raised to provide advice on how to address these requirements. The identified actions also encompass the responses to the specific queries raised by Magnox, where further is judged to be needed to close a query.

In order to support the step-wise packaging of the CXPP ILW, the Action Points have been divided into those applicable to the 'packing' of the wastes into the annular 500 litre drums and TSV overpacks and those applicable to the 'packaging' of the drummed wastes into the 4 metre box to produce the disposal packages. Action Points for both Packing and Packaging will need to be addressed in order to gain further endorsement for the appropriate stage of packaging endorsement.

Conclusions

RWM has performed an Interim stage Disposability Assessment for packages of drummed CXPP ILW material from the Chapelcross Site in vented 4 metre box waste packages. An assessment of disposability has been performed in accordance with the Joint Regulators' Guidance to Industry. The assessment has considered the consistency of the proposed packages with RWM requirements for safe long-term management, including transport, emplacement and extended storage underground, and disposal.

It has been concluded that insufficient information is available to support Interim stage endorsement and 14 Action Points have been raised to codify the necessary actions.

Notwithstanding the conclusion of the Interim stage assessment, RWM judges that the proposals should be endorsed at the Conceptual stage, this endorsement covering both the packing of the storage packages and the production of disposal packages containing CXPP ILW. This Conceptual stage endorsement is subject to a qualification, taking the form of an exclusion of the packaging of oil-containing wastes. In addition, the presence of mercury has been identified a risk to the future acceptability of the relevant component of the waste; mercury being subject to continuing consideration by RWM.