

Packaging of Contact Handled ILW at Dounreay (Conceptual Stage)**Summary of Assessment Report****Issue date of Assessment Report: 31st May 2018**

EXECUTIVE SUMMARY**Background**

Radioactive Waste Management Limited (hereafter RWM) has undertaken a Conceptual stage Disposability Assessment for the proposals by Dounreay Site Restoration Limited (DSRL) for the packaging of Contact Handled Intermediate Level Waste (CHILW) at the Dounreay site.

The objectives of this Conceptual stage assessment of proposals for packages of CHILW are to provide DSRL with:

- an assessment of disposability in accordance with the Joint Regulators' Guidance to Industry;
- supporting advice on disposability of CHILW to DSRL 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.

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). It should be noted that this assessment is completed against the 2010 DSSC but that a revised DSSC was completed in 2016 and this is shortly to be implemented by RWM in Disposability Assessments.

Scottish Government policy specifies long-term near surface, near site storage and disposal facilities, so that the waste can be monitored and is retrievable, however the regulators' view is that packages conditioned in anticipation of geological disposal, and assessed under the Disposability Assessment process, will also be suitable for long-term storage in accordance with Government policy in Scotland. Therefore the Disposability assessment

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

process can be applied to Scottish wastes. It should also be noted that reference to geological disposal in this report refers to the assessment basis, not the planned outcome.

The general requirements placed on waste packages for disposal in a GDF are embodied in the Generic Waste Package Specification (GWPS)². Further requirements for particular types of waste package are embodied in the relevant Waste Package Specification (WPS). In the case of the LETP waste packages, the relevant WPS is that for packages based on WPS/300/03 Specification for 500 litre drum waste package.

Scope of the Assessment

The majority of the CHILW currently stored at Dounreay was generated from fuel fabrication, spent fuel reprocessing and ancillary processes (residue recovery, effluent treatment etc.) performed in support of the UK's Materials Test Reactor (MTR) and fast reactor fuel cycles. Some of the CHILW was generated otherwise, from the processing of materials under commercial contracts with overseas customers. Most of the stored CHILW was generated at Dounreay, although some was produced during fast reactor fuel fabrication at Sellafield, UK and Cadarache, France. There will be future arisings of CHILW from the decommissioning of many of the facilities at Dounreay whose operation generated the current CHILW stocks.

Dounreay CHILW is now defined as comprising Plutonium Contaminated Material (PCM), Uranium Contaminated Material (UCM) and a group of materials, referred to as Highly Enriched Uranium (HEU) insoluble remnants, which have not previously been considered to be part of the Dounreay CHILW waste stream. In the past, these materials were earmarked for processing to recover their HEU content, but are now considered to be waste. The materials have the same origins as the UCM component of the CHILW.

The PCM and UCM wastes and the HEU remnants form a range of waste streams and materials defined in the UK Radioactive Waste Inventory. It is DSRL's intention in the future to combine all waste streams and HEU remnants under one single UKRWI identifier, namely 5B24.

Packaging Process

Nature of the Waste

The PCM primarily consists of ferrous metals with small amounts other materials, such as cellulose and plastics. The PCM is contaminated with finely dispersed plutonium dioxide dust and small amounts of plutonium nitrate, uranium oxide and uranium carbide.

The UCM portion of the CHILW inventory primarily consists of uranyl nitrate contaminated concrete, sand and plant residues, calcium fluoride slag wastes (from billet reduction operations) and operational and decommissioning waste such as metals from gloveboxes motors, tools, plastics and other soft wastes such as tissues and swabs.

² NDA, *Generic Waste Package Specification*, NDA Report NDA/RWMD/067, March 2012.

The HEU insoluble remnants component type is similar to UCM CHILW, with the difference being that the HEU insoluble remnants generally contain a greater U-235 enrichment.

The containers in which the CHILW is currently stored are diverse: a number of types of outer drum of 45 gallon capacity (galvanised or painted) with various kinds of inner packaging, including alkathene and cardboard liners, plastic bags and tubes, and smaller steel drums. The HEU insoluble remnants are stored in cans of various types and sizes including some aluminium cans.

Waste Processing and Packaging

The packaging strategy incorporates the consolidation of HEU insoluble remnants into the drummed PCM and UCM CHILW stream. The storage drums will be visually inspected and characterised by X-ray radiography and a variety of radiometric assay techniques (yet to be confirmed) to determine the radionuclide inventory. This will be followed by supercompaction of the storage drums to form pucks. The pucks will then be placed in 500 litre drums and grouted in place. It is estimated that between 2 and 8 pucks, with an average of 5 pucks will be placed into a 500 litre drum, subject to the puck size.

Some storage feed drums are expected to contain waste items that are not compactible. The strategy for packaging these drums is likely to involve the placement of the storage drum (with the lid removed), into a 500 litre drum, which would then be flood grouted.

The exact design of the 500 litre drum will be confirmed as the packaging proposals develop. However, DSRL states it will be constructed similarly to a previously RWM endorsed design, known as the Dounreay Mark 2 (MkII) "solids" drum.

The conditioned waste packages will be stored within the Dounreay Cementation Plant (DCP) Store Extension 2 for 500 litre drums.

Assessment Inventory and Number of Packages

The assessment average waste package radionuclide inventory was provided by DSRL based on existing inventory estimates. It is an arithmetic mean produced by dividing the estimated total radionuclide inventory of the Dounreay CHILW by the estimated number of final waste packages that would be generated from the waste.

Two maximum waste package radionuclide inventories were derived by RWM for assessment purposes, one for PCM, and one for UCM and remnants. The maximum PCM package inventory developed by RWM for this assessment is based on a DSRL fingerprint for the plutonium isotopic composition, including the associated activation and fission product impurity contamination. RWM's generic criticality safety assessment (CSA) for separated plutonium derived a waste package fissile material limit, which provides the bounding waste package inventory for the PCM. The maximum HEU and remnants waste package radionuclide inventory developed by RWM for assessment was intended to be bounding in terms of uranium fissile material content. The bounding mass of U-235 in HEU per storage drum is high, but is the smallest

maximum fissile material inventory that DSRL could work to without having to sub-divide feed drums (i.e. thus assuming a minimum of one puck per 500 litre drum waste package). This has been used as the maximum assessment waste package inventory for the HEU and remnants.

Assuming that 100% of feed drums will be supercompacted, and that an average of 5 supercompacted feed drums will be placed into a 500 litre drum, the total number of waste packages to be produced will be 1363 packages.

Assessment of Disposability

Waste Package Properties and Performance

RWM considers that the 'as manufactured' 500 litre CHILW wasteforms are likely to perform adequately in the context of mechanical and physical properties. In addition, evolution of the 500 litre CHILW wasteforms is unlikely to have any significant detrimental effect on wasteform properties.

In impact and fire faults that the waste package could be exposed to, the waste package is expected to perform similarly to other 500-litre drums containing grouted supercompacted waste. The grout annulus around the pucks within the 500 litre drum waste container is expected to provide substantial protection. For assessment purposes, standard Release Fractions for this type of package have been applied.

Compliance with the Transport System Design and Safety Case

The use of the 500 litre drum would be consistent with meeting the transport system design as currently foreseen by RWM. However, as the 500 litre design, manufacturing drawings and manufacture specification document has not been provided by DSRL, at the present time compliance is not proven. The proposed waste packages are expected to comply with the transport system design and safety case, on the assumption that an appropriate Criticality Safety Assessments (CSA) can be developed. The most challenging aspect is likely to be deriving and demonstrating compliance with a Safe Fissile Mass. DSRL submitted a package specific RHILW CSA, however, this may not be applicable to CHILW. The RWM generic CSA for separated plutonium and HEU could be used, however, the Safe Fissile Mass is restrictive. Therefore, it is likely that a package specific CSA for CHILW that takes credit for specific package characteristics is required.

The use of the 500 litre drum would be consistent with meeting the transport system design as currently foreseen by RWM.

Compliance with Engineering Design and the Operational Safety Case

The use of standard package design, a 500 litre drum, is expected to ensure the package is compliant with the engineering design of the GDF. It is noted that RWM assumes that DSRL would load the 500 litre drum waste packages to transport and disposal stillages on export from Dounreay.

The Operational Safety Assessment shows that release of inventory from wastes packages involved in impact and fire faults will not result in public doses that would be above the relevant Basic Safety Level (BSL). One fault is identified that exceeds the relevant BSL for worker dose. For this Design Basis Fault, control measures, which are indicated in the Generic Operational Safety Case – Volume 3, will be implemented that will reduce the 'Protected'

dose from this fault. In addition to the safety measure in place for the Design Basis Fault, other safety measures will also act to control the risk from all faults to the ALARP level.

The assessment found that 'Protected' doses reported in this assessment do not exceed those of the Bounding Waste Streams in the Operational Safety Case.

Compliance with the Environmental Safety Case

At the Conceptual stage it is concluded that the proposed packages of CHILW are likely to be disposable. Further information will be required at the Interim assessment stage to confirm the composition of the wastes. Development work is also required to produce a suitable CSA.

Status of Management System and Data Recording

The submission contains a draft Waste Product Specification (WPrS), a draft Package Record Specification (PRS), a draft Data Recording Methodology (DRM) and draft Criticality Compliance Assurance Documentation (CCAD). The submitted documents are considered to be consistent with endorsement at Conceptual stage, although advice on further required development has been provided.

It is unclear to what extent DSRL is relying on historic records and which radionuclides this covers, nor what will happen if the assay and historic records do not match up. It is also not clear how fingerprints will be applied in the data recording process. The draft PRS covers the appropriate topic areas but will need to be developed further as the project progresses to provide content.

Conclusions of Assessment of Disposability

Overall, it is expected that the proposed waste packages are capable of complying with the plans for geological disposal and that a disposability case can be developed.

Requirements for Further Work

The key development requirements in processing the case for packaging of CHILW in 500 litre drums are:

- Improved physical and chemical inventory;
- Development of the supercompaction process, and evidence that the wasteform will meet the longevity and safety requirements;
- Provision of the manufacturing drawings and the manufacturing specification for the waste container;
- Production of a package specific CSA for CHILW waste packages or application of a more restrictive generic CSA;
- Develop the key management systems documents; and
- Submit further information on the waste management options investigated for treatment of CHILW and confirm the regulator is aware that HEU remnants is being treated as waste rather than recyclable material.

Conclusions

Based on the Assessment of Disposability, it has been concluded that the proposed waste packaging proposal can be endorsed at the Conceptual stage through issue of a Letter of Compliance. The assessment has identified 21 Interim stage Action Points that need to be resolved to progress the endorsement of packages to the Interim assessment stage.