Nuclear Decommissioning Authority

Radioactive Waste Management Directorate

Packaging of Trawsfynydd Pond FED and Skips (Final stage)

Summary of Assessment Report

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Introduction

This Assessment Report provides the basis and findings of the Final stage Disposability Assessment by NDA Radioactive Waste Management Directorate (hereafter RWMD) for three packages of Trawsfynydd Pond Fuel Element Debris (FED) and Skips in 3 m³ Boxes.

Background and scope of assessment

The objectives of this Final stage assessment of proposals for packages of Trawsfynydd Pond Fuel Element Debris (FED) and Skips in 3 m³ Boxes are to provide Magnox with:

- An assessment of disposability in accordance with the Joint Regulators' Guidance to Industry
- Endorsement of the waste packages via issue of a Final stage Letter of Compliance (LoC).

Further information on the Letter of Compliance process is available elsewhere[1].

Consideration has been given to the compatibility of the packages of Trawsfynydd Pond FED and Skips in 3 m³ Boxes with the requirements for safe long-term management, including transport, emplacement and extended storage underground, and disposal, as currently expressed for the Illustrative Geological Disposal Concepts for Intermediate Level Waste and Low Level Waste (ILW/LLW). The illustrative concepts have been developed as part of the programme to implement a Geological Disposal Facility for the UK's higher activity wastes. This assessment also addresses compatibility with the relevant Waste Package Specification (WPS); the specification for the side lifting variant of 3 m³ Box waste package[2]. An essential component of this includes consideration of the effects of interim on-site storage of the conditioned waste at Trawsfynydd.

The 3 m³ Box waste package is an unshielded ILW (UILW) package. It is assumed that such a waste package would be transported to the GDF in a shielded waste transport container (SWTC), the combination of waste package and transport container being classed as a Type B transport package under the IAEA Transport Regulations.

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1 NDA, *Waste Package Specification and Guidance Documentation: WPS/650 Guide to the Letter of Compliance Assessment Process*, WPS/650/02, March 2008

2 NDA, *Waste Package Specification and Guidance Documentation: WPS/310 Specification for side lifting variant of 3 cubic metre Box Waste Package*, WPS/310/03, March 2008.

The GDF transport system considers the use of sea, rail or road. Normally, transport packages would be ready for almost immediate transfer underground upon receipt, so they would be admitted to a package transfer facility where they would be lifted off the arrival vehicle, monitored and transported underground.

Access to the underground facilities would be via a shaft or inclined drift, depending upon the host geology. UILW would be transported underground to an operational inlet cell. Once inside the shielded inlet cell, the UILW would be removed from its SWTC and transferred to the disposal vault, for emplacement via a remotely operated overhead crane.

Waste packages

The Magnox reactor situated at the Trawsfynydd site operated from 1965 until reactor shutdown in 1991. Spent Magnox fuel from the reactor was discharged into cooling ponds on site where it was desplittered prior to being sent to Sellafield for reprocessing. Solid FED was consigned to one of two vaults on site; however, following the removal of fuel elements, skips and equipment from the cooling ponds, residual solid FED remained.

The waste included in the current submission, and scope of endorsement, is the residual FED retrieved from the pond floor and placed into three skips during May 1998, and subsequently packaged in 3 m^3 Boxes in December 1998. The waste comprises Magnox FED, Nimonic springs and three contaminated fuel skips; there are some small scrap items and concrete blocks. The Nimonic springs are all contained within a sacrificial mild steel shielded pot. A superplasticised cementitious grout was used to encapsulate the waste.

The packaged waste forms the entirety of the 2010 UK Radioactive Waste Inventory waste stream 9G48/C; *Encapsulated Skips and Debris from Fuel Cooling Pond*. The waste stream comprises three waste packages.

Wasteform production was based upon common practice for the immobilisation of solid wastes, i.e. packaging in 3 m^3 Box waste containers and infiltration using a fluid BFS/OPC-based cementitious grout. Essentially, the Trawsfynydd Pond FED and Skip wasteform comprises cement encapsulated solid items within a skip, surrounded by a cementitious grout annulus.

The Trawsfynydd Pond FED and Skip waste packages have been stored within Mk 1 (non-vented) concrete overpacks in the Ponds complex and in the Reactor 1 and 2 Basement Stores. It is planned to swap the overpack to a vented Mk 3 design and transfer the packages to the ILW Store.

RWMD considers that the ‘as manufactured’ Trawsfynydd Pond FED and Skip wasteforms are likely to perform adequately in the context of mechanical and physical properties. In addition, evolution of the Trawsfynydd Pond FED and Skip wasteforms is unlikely to have any significant detrimental effect on wasteform properties.

The waste container is based on the generic 3 m^3 Box design developed in the mid-1990s, specifically the Nirex generic 3 m^3 Box with lid Variant 1, but modified to incorporate a larger opening and changes to a range of other details. The Trawsfynydd container is considered by RWMD to represent ‘sound engineering’ best practice and was designed to meet the requirements of the transport and GDF systems (based upon a six-high stack).

Outcome of assessment

Compliance with the transport system design and safety case

The design of the Trawsfynydd Pond FED and Skip waste packages, including mass and activity content, does not place any constraints on the type of SWTC deployed for transport or on mode of transport.

The heat output for a maximum activity 3 m³ Box waste package at 2040 does not present a challenge for the transport limit of 200 W.

The IAEA Transport Regulations limit the maximum normal operating pressure of a Type B transport package to less than 700 kPa (gauge). This places an upper limit on the bulk gas generation rate of the contents of a Transport Package. The bulk gas generation rate for the average waste package is insignificant (0.03%) when compared to the limit for the SWTC.

Under normal conditions the Transport Regulations-specified release from the transport package must be less than 10^{-6} A_2 per hour. The waste container is assumed to maintain containment of any particulate during normal conditions of transport, therefore only containment of gas is considered under normal conditions. The predicted peak rate of release of gaseous nuclides (H-3, C 14, Kr 81, Kr-85, Ar-39, Ar-42 and Rn-222) from the packages was assessed to be insignificant (0.0003%) in terms of the limit.

Under accident conditions the Transport Regulations-specified release of radioactive material is required to be less than 1 A_2 in the week following the accident. The maximum radionuclide inventory for Trawsfynydd Pond FED and Skip waste packages has been combined with the waste package proposal specific impact and fire Release Fractions for assessment against the accident containment limits for a 3 m³ Box in a SWTC. The predicted releases indicate that this waste represents 0.3% of the activity limit for fire and 0.2% of the activity limit for impact.

The impact of the Trawsfynydd Pond FED and Skip waste packages on expected transport dose to workers has been assessed. The existing baseline waste stream 9G48/C (based upon 2007 UK RWI data) was replaced with the modified waste package description. In effect, this methodology quantifies the change in the dose to operators from a change in the packaging assumptions. The change in waste packaging assumptions does not have any implications on the safety argument presented in the Transport System Safety Assessment.

The waste package fissile material content of <2 g is below the screening level of 47 g as defined in the RWMD general Criticality Safety Assessment (CSA) and therefore of no significance in the context of transport criticality safety.

Overall, RWMD considers the Trawsfynydd Pond FED and Skip waste packages to be compliant with the transport system design and safety case as currently foreseen.

Compliance with engineering design and the Operational Safety Case

RWMD considers that the Trawsfynydd FED and Skip 3 m³ Box waste packages are generally compliant with the disposal system engineering design as currently foreseen. However, the packages are not fully compliant with stacking requirements insofar as they have not been demonstrated to be suitable for seven-high stacking. On this basis the waste packages are likely to require selective emplacement.

The consequences of Design Basis Analysis faults involving Trawsfynydd Pond FED and Skip waste packages have been assessed. The predicted doses from impact, external exposure and contamination faults are significantly below Basic Safety Objective (BSO) for both public (0.01 mSv) for workers (0.1 mSv). The predicted doses from fire faults are below BSO for workers. However, predicted public doses

for bare UILW package fire faults are above the BSO, although they remain below the Basic Safety Limit (BSL; 1 mSv). RWMD considers that the current conservatism in the fire RFs provides sufficient confidence that a safety case could be made for the disposal of these packages from a fire perspective.

The total predicted contribution to worker dose from the three waste packages would not contribute significantly to the annual worker dose.

The waste package fissile material content of <2 g is below the screening level of 47 g as defined in the RWMD general CSA and therefore of no significance in the context of operational criticality safety.

Overall, RWMD considers the waste packages to be compliant with the disposal system Operational Safety Case as currently foreseen.

Compliance with the Environmental Safety Case

The results of the assessment of radioactive gas releases from Trawsfynydd Pond FED and Skip waste indicates that predicted doses from these waste packages are consistent with the Operational Environmental Safety Case (OESC). RWMD considers that the very low levels of chemotoxic materials likely to be present in the waste packages would not be expected to give rise to a significant risk at the GDF or off-site.

The generic DSSC addresses higher strength rock geology in terms of calculations of performance, addressing other geologies in more qualitative terms. Since the Trawsfynydd Pond FED and Skip waste stream has been assessed through the generic Disposal System Safety Case (DSSC) and its associated inventory, the assessment of post-closure safety is based on a relatively simple screening assessment to check whether the expectations for the waste steam used in the generic Post Closure Safety Assessment (PCSA) are still appropriate. All radionuclides present in the Trawsfynydd pond FED and Skips waste stream inventory are screened from further consideration with regard to the groundwater pathway.

In general, RWMD expects BFS/OPC-based cement-encapsulated wastes to perform adequately in respect to pH buffering and compatibility with the UILW vault backfilling system. Although the alternative geological environments may, in some cases, necessitate different backfilling arrangements, and the use of different materials, there are no features of the Trawsfynydd Pond FED and Skip waste packages that would preclude the use of the necessary backfills.

Organic materials and their degradation products have the potential to affect the behaviour of radionuclides in a GDF. Although the encapsulant grout used in these waste packages includes a superplasticiser, and skips are painted with an organic paint, a conservative analysis of the total mass of organic material associated with the three Trawsfynydd Pond FED and Skip waste packages is insignificant compared to the total cellulosic material considered to be present in the UILW vaults. RWMD considers it prudent, however, to record a potential requirement for selective emplacement of the waste packages due to their superplasticiser content as a Qualification to any LoC endorsement.

The predicted peak total bulk gas generation rate during the post-closure period is an order of magnitude lower than the UILW average and this, together with the fact that there are only three waste packages, means that the post-closure bulk gas generation from these packages is of little consequence to the generic PCSA.

RWMD considers that the very low levels of chemotoxic materials likely to be present in the waste packages would not be expected to give rise to a significant risk in the context of post-closure safety.

RWMD considers that the predicted rates of radioactive gas release are unlikely to be significant in the context of post-closure safety.

The waste package fissile material content of <2 g is below the screening level of 47 g as defined in the RWMD general CSA and therefore of no significance in the context of post-closure criticality safety.

RWMD considers that the Trawsfynydd FED and Skip 3 m³ Box waste packages are compliant with the disposal system environmental safety requirements as currently foreseen, as the packages are compliant with the generic OESA and the generic PCSA.

Compliance with Waste Package Specification

Comparison with the requirements of WPS/310 has indicated that Trawsfynydd Pond FED and Skip waste packages are generally compliant with the WPS. However, shortcomings have been identified in the following areas:

- Stackability
- Quality management
- Waste package data and information recording.

Statement of disposability

The assessment of the submission has not identified any issues that would preclude issue of a Final stage LoC for Trawsfynydd Pond FED and Skip waste packages. As such, no Action Points have been identified.

However, the following compliance gaps have been identified:

- Compliance Gap 1; Trawsfynydd Pond FED and Skip waste packages have not been demonstrated to be suitable for seven-high stacking
- Compliance Gap 2; Trawsfynydd Pond FED and Skip waste package data records are incomplete
- Compliance Gap 3; Knowledge of chloride deposition rates in the Mk 3 overpacks or ILW Store is required
- Compliance Gap 4; No controlling document exists for onward waste package and information management
- Compliance Gap 5; Quality Plan sign-off is incomplete for waste package manufacture.

RWMD considers it appropriate to manage the requirements related to these compliance gaps as Qualifications to the Final stage LoC (as listed below). An additional Qualification is required relating to a potential requirement for selective emplacement due to the superplasticiser content of the wasteform.

Conclusions

The conclusion of the assessment is that the packaging of Trawsfynydd Pond FED and Skips into 3 m³ Box containers is compatible with the requirements we see as necessary for transport, handling and disposal.

RWMD has therefore provided Final stage endorsement of the waste packages, with Qualifications, via LOC/17466732 Issue 1.

RWMD anticipates removal of the LoC Conditions via re-issue of the LoC following technical audit of the appropriate information to be provided by Magnox, with a target date for the final audit of June 2013.