

Miscellaneous Activated Components at Trawsfynydd Power Station (Periodic Review)

Summary of Assessment Report

Issue date of Assessment Report: 8 May 2013

Introduction

This Assessment Report provides the basis and findings of the Periodic Review Disposability Assessment by NDA Radioactive Waste Management Directorate (hereafter RWMD) for the 32 completed packages of Trawsfynydd Miscellaneous Activated Components (MAC) waste in 3m³ Boxes, designated as waste streams 9G36/C and 9G37/C in the UK Radioactive Waste Inventory.

The reference basis for this assessment of disposability is the conceptual designs for a Geological Disposal Facility (GDF) derived from the generic Disposal System Safety Case (DSSC).

The objectives of Periodic Review disposability assessments are to maintain the currency of the disposability case and to provide the waste producer, in this case Magnox, with confirmation of the endorsement of the completed waste packages via re-issue of the Final Stage Letters of Comfort / Compliance (LoC), in the case of the MAC wastes, granted in 2001, 2008 and 2010.

Further information on the Letter of Compliance process is available elsewhere¹.

Background and scope of assessment

The assessment covers the compatibility of the packages of Trawsfynydd MAC in 3m³ Boxes with the requirements for safe long-term management, including transport, emplacement, 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), in this case the specification for the side lifting variant of 3m³ Box waste package², actual plant performance and any non-conforming packages. An essential component of this assessment includes consideration of the effects of interim on-site storage of the conditioned waste at Trawsfynydd.

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 3m³ 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 standard 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.

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.

Waste packages

The two Magnox reactor situated at the Trawsfynydd site operated from 1965 until reactor shutdown in 1991. Miscellaneous Activated Components (MAC) were consigned to two vaults on site below the two reactor buildings during this period.

The waste included in the current submission, and scope of existing endorsements, comprises activated carbon steel and graphite components plus smaller quantities of other activated materials (stainless steel, thermocouples, nimonic, aluminium and Magnox). In addition, the contaminated HEPA filters used to control particulate material releases from the disposal vaults and vacuum filters from the operations to collect dust from the vaults have been packaged as part of the waste stream. Based on package records, the total mass of the wastes is 38,970 Kg of which it is estimated, based on vault disposal records and excluding the HEPA and vacuum filters, that 79.5% of the waste is iron or alloyed iron and 20% is carbon (as graphite). The remaining 0.5% is largely chromium (0.26%) and nickel (0.21%), as components of stainless steel and thermocouple alloys, with less than 0.1% aluminium and 0.01% magnesium, titanium and silver.

The packaged waste forms the entirety of the 2010 UK Radioactive Waste Inventory waste streams 9G36/C and 9G37/C; titled *Conditioned Miscellaneous Activated Components*. The waste stream comprises 32 waste packages, consisting of side-lifting 3m³ boxes.

Wasteform production was based upon common practice for the immobilisation of solid wastes, i.e. infiltration using a fluid PFA/OPC-based cementitious grout. Essentially, the wasteform within each of the 32 Trawsfynydd MAC waste packages comprises cement encapsulated solid items within 8 steel baskets, surrounded by a cementitious grout annulus.

There were some issues with container fabrication related to the weld fabrication methods used. There were also a small number of minor non-conformances in package manufacture and inspection. Apart from these issues, which have Action Points relating to them raised in this review, the packages were produced as planned and actual plant performance followed the agreed WPrS. This is confirmed by package records and audits by RWMD.

The Trawsfynydd MAC waste packages have been stored since their manufacture within Mk 1 (non-vented) or Mk 2 (vented) concrete overpacks in the Reactor 1 and 2 Basement Stores. It is planned to swap the overpacks to a vented Mk 3 design, which more closely follows the ambient environmental conditions compared to Mk 1 and Mk 2 overpacks, before transferring the packages to the purpose-designed Trawsfynydd ILW Store.

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

The waste container is based on the generic stainless steel 3m³ Box design developed in the mid-1990s, specifically the Nirex generic 3m³ Box with lid Variant 2, but modified to incorporate changes to a range of 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 six-high stacking, which was the specified requirement at the time).

Outcome of assessment

Compliance with the transport system design and safety case

The design of the Trawsfynydd MAC waste packages, including mass and activity content, mean that an SWTC-285 would be deployed for transport, the external dose rates marginally exceeding the limits for an SWTC-70.

The heat output for a maximum activity 3m³ Box waste package at 2040 (0.042 W) is well within the transport limit³ 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 assessed to be insignificant (< 0.05 %) when compared to the limit for the SWTC.

Under normal conditions the release rate from the transport package must be less than the Transport Regulations-specified 10⁻⁶ A₂ 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 A₂ in the week following the accident. The maximum radionuclide inventory for Trawsfynydd MAC waste packages has been combined with the waste package specific impact and fire Release Fractions for assessment against the accident containment limits for a 3m³ Box in a SWTC. The predicted releases represent 2.5% of the activity limit for both fire and impact.

The impact of the Trawsfynydd MAC waste packages on expected transport dose to workers has been assessed. The packages do not have any implications for the safety arguments presented in the Transport System Safety Assessment.

The waste package fissile material content of < 1 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. A Criticality Compliance Assurance Document was produced to demonstrate compliance and this was accepted by RWMD.

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

³ This figure has been revised to 400 W in the March 2013 revision of the WPS, the earlier WPS was used as the basis for this Periodic Review Disposability Assessment, however where the WPS figures have been revised they have no impact on the conclusions of this review.

Compliance with engineering design and the Operational Safety Case

RWMD considers that the Trawsfynydd MAC 3m³ Box waste packages are generally compliant with the disposal system engineering design as currently foreseen.

The consequences of Design Basis Analysis faults involving Trawsfynydd MAC waste packages have been assessed. The predicted doses from impact, external exposure and contamination faults are significantly below the Basic Safety Objective (BSO) for both public (0.01 mSv) for workers (0.1 mSv). The predicted doses from fire faults are below the BSO for workers. However, predicted public doses for bare UILW package fire faults are above the BSO, although they remain below the most restrictive Basic Safety Level (BSL) of 1 mSv. RWMD considers that the current conservatism in the fire RFs provides sufficient confidence in the safety case for the disposal of these packages from a fire perspective.

The results of the assessment of radioactive gas releases from Trawsfynydd MAC 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 total predicted contribution to worker dose from the 32 waste packages would not contribute significantly to the annual worker dose.

As noted above, the waste package fissile material content of < 1 g is below the screening level of 47 g as defined in the RWMD general CSA, and the Criticality Compliance Assurance Document has been accepted by RWMD.

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

Compliance with the Environmental Safety Case

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

In general, RWMD expects PFA/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 MAC 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 waste stream has been packaged along with the vault HEPA filters and vacuum filters (assumed to be organic) from the vault dust and residue collection operations, a conservative analysis of the total mass of organic material associated with the Trawsfynydd MAC waste packages indicates it is insignificant compared to the total cellulosic material considered to be present in the UILW vaults, and is therefore considered to be of no consequence in this assessment.

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 32 waste packages, means that the post-closure bulk gas generation from the waste stream 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.

As for operational safety, the waste package fissile material content of < 1 g is below the screening level of 47 g as defined in the RWMD general CSA and as presented in the Criticality Compliance Assurance Document, which has been accepted by RWMD.

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

Compliance with Waste Package Specification

Comparison with the requirements of WPS/310⁴, the Waste Package Specification (WPS) for the Side-Lifting Variant 3m³ Box Waste Packages, has indicated that the Trawsfynydd MAC waste packages are generally compliant with the WPS. However, shortcomings have been identified in the following areas:

- Quality management
- Waste package data and information recording.

These relate to i) full procedures not being in place for forward management and data recording related to package monitoring and storage and ii) package records not being fully complete and cross referenced.

Statement of disposability

The assessment of the submission has identified issues that preclude re-issue of the existing Final Stage LoCs for Trawsfynydd MAC waste packages at this time. The issues identified relate to incomplete package records and quality plans, uncertainty over the as built containers, definition of the baseline condition of packages when placed in the ILW store and the lack of a controlling document for waste package and information management following package manufacture.

Compliance Gaps have been identified in the assessment. RWMD considers it appropriate to manage the requirements related to these Compliance Gaps as Action Points to be addressed before the Final stage LoCs can be re-issued.

⁴ See footnote on page ii.

Conclusions

The conclusion of the assessment is that the packaging of Trawsfynydd MAC into 3m³ Box containers is generally compatible with the requirements we see as necessary for transport, handling and disposal. A number of compliance gaps have however been identified and related Action Points raised.

The Action points relate to:

- Completing the existing package records to make them compliant with the Magnox Company Standard for managing package records for ILW waste packages. This should include providing full container design and manufacture records (including copies of approved container drawings), with, where relevant, concessions granted to fabricators and signed approval by the Magnox design authority.
- Confirming that all operations defined in the waste packaging quality plan have been performed and that inspection records are complete.
- Providing a document with supporting implementation documentation for control of waste package storage and updating of package records related to storage and monitoring, including package surface chloride contamination measurements. This document should also include procedures for the transfer of package records from the Trawsfynydd Packaging Project to the ILW Store Manager and, subsequently, the proposed Berkeley Hub.

RWMD requires that the Actions Points are addressed by Magnox, following which a technical audit of the appropriate information will be carried out. Subject to a satisfactory outcome, a Final Stage LoC covering all the MAC wastes would be issued, replacing the 3 existing Final Stage LoCs that currently cover the MAC wastes.