Radioactive Waste Management Directorate

Packaging of JET Decommissioning Wastes (Conceptual stage)

Summary of Assessment Report

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Background to assessment

UKAEA has tendered a submission seeking Conceptual Stage endorsement for the waste packages that would arise from the decommissioning of the Joint European Torus (JET) experimental fusion reactor at Culham. The proposals encompass those decommissioning wastes that are expected to require conditioning and packaging as intermediate level waste (ILW).

This document summarises the results of an independent assessment carried out by Nirex in response to the submitted proposals. 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 Phased Geological Repository Concept (PGRC). Further information on the Letter of Compliance process is available elsewhere[1].

JET is an experimental fusion reactor based at the Culham site in Oxfordshire. The plant comprises the torus, a large-scale vacuum system providing magnetic confinement of the fusion plasma, and the associated facilities for storing, handling and retrieving the various gases, including tritium, that provide the reactants used to generate the reaction plasma. The torus and associated components are massive, and the total mass of the ultimately redundant plant comprises several tens of thousand tonnes. Only a small fraction of this mass would be sufficiently activated or contaminated so as to necessitate packaging for disposal as ILW, and is the subject of the assessment summarised here.

The submission covers a number of different types of ILW waste:

- decommissioning wastes arising from the dismantling of the JET torus itself;
- scrap components accumulated during the operation of the torus (for example scrap tiles from the lining of the torus);
- decommissioning wastes arising from the dismantling of the Active Gas Handling Facility (AGHF), including catalysts, absorbers and depleted uranium used in tritium management;
- other accumulated operational wastes (predominantly ‘soft’ wastes such as gloves, overalls, tissues, *etc*).

For the purpose of assessment, and potentially for packaging, these wastes have been grouped into two categories: wastes associated with the torus and waste from the AGHF (including the soft operational wastes).

[1] *The Nirex Process for Assessment of ILW Conditioning and Packaging Proposals*, Nirex Technical Note, March 2006 (Nirex document reference #497789).

The proposals for conditioning and packaging of the wastes as ILW represent one option that is being considered in the development of the strategy for decommissioning the JET facilities. Others may include extended storage to allow radioactivity to decay, incineration and extensive decontamination. Only the option of packaging for ultimate disposal as ILW has been assessed by Nirex.

The waste represents only a small fraction of the total volume of ILW predicted to arise in the United Kingdom (an estimated 87 of the proposed 2 metre Boxes) and contributes substantially less than 0.1% to the total radionuclide inventory of any of the significant longer-lived radionuclides. The only radionuclide present in significant quantity is tritium.

Packaging proposals

An extensive programme of dismantling and decontamination would be undertaken prior to the packaging of the waste. This would include the recovery of remaining bulk tritium for reuse or treatment elsewhere. The operational wastes and other wastes from the AGHF would then be pre-treated by shredding and immobilisation.

It is proposed that the wastes would be packaged into stainless steel 2 metre Boxes. In order to meet the requirements for the containment of tritium, it is further proposed that a fully sealed inner container should be used within each 2 metre Box. The design of the inner container remains to be fully developed, but it is proposed that it would be closed with a welded lid and would be lined and capped with a 20mm thick polymer coating. The waste itself would be loaded into the inner containers using any necessary furniture. The proposal would lead to the wastes being encapsulated within the inner container using a standard immobilisation cement grout. Some of the AGHF wastes would be additionally immobilised into smaller containers using a polymer encapsulant.

The current baseline strategy for the Culham site is based on early clearance, with JET decommissioning completed by 2020. This requires site clearance well in advance of the currently anticipated availability of a national disposal facility. Consequently, the current proposals assume that packaged wastes would be moved to a different, currently unspecified site for interim storage to await transport for disposal.

Assessment of Disposability

The acceptability of the proposed packages has been assessed against criteria established within the Nirex PGRC and associated Generic Waste Package Specification (GWPS).

The Assessment of Disposability is based upon the inventory data supplied by UKAEA, and is derived from conservative assumptions regarding the degree of tritium contamination of the wastes and modelling of the activation of components of the torus by neutrons. The submission has noted that this information is preliminary and undertakes that further refinement would be done prior to the Interim Stage. This position has been accepted as consistent with expectations at the Conceptual Stage.

The proposed 2 metre Box waste packages examined herein are, at this Conceptual Stage, judged to be generally consistent with Nirex standards and specifications for waste packages. Numerous analogues of the proposed wasteform are available and the associated development work assessed previously by Nirex provides confidence that an adequate wasteform could be produced for the JET decommissioning wastes. Nevertheless, it is also concluded that the use of a sealed inner container is novel, and further justification for this aspect of the proposal is sought.

The waste initially would be packaged into the inner containers and these would be used for the interim storage of the waste until transport to an alternative site is required. At such a time, the inner containers would be loaded into 2 metre Boxes for transport and subsequent management. The proposals therefore initially lead to the production of non-standard packages, giving rise to a 'compliance gap' when considered against Nirex waste packaging standards. Nevertheless, it is accepted that these containers can readily be converted into compliant packages by loading into 2 metre Boxes.

The assessments of transport safety show that it should be possible for the 2 metre Boxes containing JET decommissioning wastes to comply with all relevant transport safety criteria provided that the necessary degree of containment of tritium is maintained. In the event of failure of containment, it is possible that the packages would not comply with requirements.

Similarly, the assessments of operational safety show that it should be possible for 2 metre Boxes containing JET decommissioning wastes to be handled and stored safely within a repository based on the PGRC. A conservative treatment of the potential risk arising from the release of the tritium suggests that regulatory limits would not be breached, although significant doses might still be received by workers.

The post-closure safety assessment revealed no significant areas of concern that should prejudice disposal of packages containing JET decommissioning wastes. This is due to the relatively small number of packages containing the materials, and the relatively small and short-lived radionuclide inventory associated with them.

The waste does not contain fissile material and therefore the proposed packages would not present a significant criticality hazard.

In summary, the Assessment of Disposability has concluded that a Disposability Safety Case ultimately could be made for packages containing JET decommissioning wastes provided that tritium containment can be maintained. However, the current proposals for providing this containment through the use of a sealed container are novel, and further evidence to support the practicability and acceptability of such a container is required before the packaging of these wastes could be endorsed at the Conceptual Stage.

During the course of the assessment, areas requiring additional work to progress the proposals to endorsement at the Conceptual Stage, and further work required at the Interim Stage, were identified, and are summarised below.

Requirements for further development work

The following characteristics of the JET decommissioning waste packages are especially significant from the point of view of transport and repository design and safety cases:

- the rate of release of tritium from the sealed inner container under routine transport and storage conditions;
- the rate of bulk hydrogen evolution following grouting due to corrosion of wastes and associated detrimental effects on the wasteform and the continued integrity of the sealed inner container;
- the general compatibility of the use of a sealed container with the expectations of the Nirex PGRC, and the potential risks arising from excessive pressurisation;
- the use of a polymer encapsulant to immobilise the potentially loose material from the AGHF. Such encapsulants have been demonstrated to be effective in other applications.

The identification of these key characteristics provides a focus for development work. It is further noted that, where appropriate, such development would need to be based on a suitable simulant of the waste.

Conclusions

The assessment of the proposals has concluded that the eventual packages containing waste from both categories of JET decommissioning wastes are potentially consistent with disposal under the PGRC. However, further evidence to support the practicality and acceptability of such a container is required before the packaging of these wastes could be endorsed at the Conceptual Stage.

The potential consistency of the proposed waste packages with the PGRC has been demonstrated through the provision of a Conceptual Stage Assessment of Disposability.