

Packaging of Miscellaneous Activated Components Removed from Magnox Fuel Element Debris at Sizewell A Decommissioning Site (Conceptual stage)

Summary of Assessment Report

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Background

British Nuclear Group Magnox Electric Ltd has sought Conceptual stage endorsement for the production of disposable waste packages containing Miscellaneous Activated Components (MAC) from Sizewell A decommissioning site. This MAC waste is currently associated with the Magnox Fuel Element Debris (FED) stored in three wet cells at Sizewell A.

This document summarises the results of the assessment carried out by NDA Radioactive Waste Management Directorate (RWMD) in response to the submitted proposals. The assessment has been carried-out as part of the Letter of Compliance process, whereby RWMD 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 elsewhere¹.

During the course of this assessment, the structure of British Nuclear Group Magnox Electric Ltd has been revised and this report is therefore directed to the new organisation having responsibility for Sizewell A, Magnox South.

Scope of the Proposals

During the operation of Sizewell A power station, Magnox FED was generated from the treatment of spent Magnox reactor fuel prior to transport to Sellafield for reprocessing. A number of high specific activity components arising from activation in the reactors were also collected during this treatment process. These items predominantly consist of small springs made from nimonic alloy, thermocouple wires and Magnox fuel element top-end fittings. These items are collectively referred to as MAC. The MAC and the FED were collectively stored in three cells within the Splitter Vane Stores.

The proposals involve retrieval of the MAC and FED from the cells, segregation of the MAC from the FED and any assorted fuel fragments and conditioning and packaging of the MAC Ductile Cast Iron (DCI) drums. The separated FED and any identified fuel fragments would be treated together using a different process and this has recently been subject to separate assessment by RWMD². It is estimated that the arisings of MAC will be small in comparison to arisings of FED and will result in the production of just three DCI drums. The DCI drums containing the encapsulated MAC would be stored in the ILW store at Sizewell A until such time as a national facility for disposal of ILW becomes available. At that time, each of the DCI drums may be transferred to a stainless steel 3m³ Box where the voidage surrounding

¹ *Guide to the Nirex Letter of Compliance Process*, Nirex Document WPS/650, June 2006.

² NDA, *Conceptual Stage Letter of Compliance for the Packaging of Fuel Element Debris* from Sizewell A Decommissioning Site, LOC/532584, April 2007

the drums would be filled with cement grout. This additional layer of containment would afford further shielding and handling benefits for transportation purposes.

The MAC has been accounted for in the National Radioactive Waste Inventory as part of the Sizewell A FED waste streams but it does not represent a significant fraction of the total inventory of ILW in terms of either radioactivity or volume.

Packaging Proposals

The proposals for packaging and disposal of the MAC associated with the FED at Sizewell A involve:

- Retrieval of the MAC and FED from the three storage cells at Sizewell A;
- Sorting of the waste to identify and remove the MAC from the FED;
- Washing the MAC to segregate any adherent sludge which might be present;
- Transfer of the MAC into a DCI drum;
- Immediate encapsulation of the MAC inside the DCI drum with a cementitious grout;
- Addition of a capping grout;
- Attachment and bolting of the drum lid;
- Transfer of the completed packages to the Sizewell A ILW store for storage for a period of up to 100 years pending the availability of a national ILW disposal repository;
- Overpacking of the individual DCI drums inside 3m³ Boxes prior to transport to the repository.

This Assessment Report details the RWMD assessment of these proposals for Sizewell A MAC. The proposed use of DCI as the material for drum manufacture raises corrosion performance issues, which would not be relevant to containers made from stainless steel. Magnox South has flagged that the option to overpack the DCI drums inside 3m³ Boxes prior to transport and disposal will be available. This assessment has considered the disposability implications for two alternative waste package end points:

- Bare DCI drums; and
- Individual DCI drums cement grouted inside 3m³ Box overpacks.

Assessment of Disposability

The acceptability of the proposed packages has been assessed against criteria established within the PGRC and associated GWPS.

The Assessment of Disposability is based upon a set of radionuclide inventories derived by RWMD using a series of assumptions of waste composition. Magnox South will be required to confirm that these derived inventories are suitably representative of the MAC waste. It is expected that future assessment stages will utilise radionuclide inventories based on waste records and/or results from FED cell sampling programmes.

It is expected that a suitable wasteform could be produced from the encapsulation of the MAC using a high fluidity grout, provided that Magnox South can provide an effective means of removing any sludge that may be adherent on the MAC following its removal from the cells. Similar grout formulations have been used at Trawsfynydd decommissioning site for encapsulating FED and it has been demonstrated that a good wasteform with low voidage can be produced.

The proposed DCI drums are non-standard packages due to their mass which would exceed the 2 t weight limit specified for 500 litre Drums. The extra weight of these containers is due to the 185 mm thick container walls. The shielding provided is advantageous in terms of limiting the external dose rate from the high specific activity wastes but is inefficient in terms

of waste volume utilisation. The DCI drums are also highly robust containers such that under accident scenarios, releases of radioactivity from these packages would be expected to be low. Overpacking the drums for transport and disposal using a 3m³ Box would create a standard waste package. Such an overpack would further enhance accident performance by providing defence in depth. Waste release fractions are improved further still by the nature of the MAC wastes, which comprise activated solid items that are generally resistant to degradation through corrosion.

The assessments of transport safety show that it should be possible for both the bare DCI drum and DCI drum overpacked inside a 3m³ Box packaging options to comply with all relevant transport safety criteria when transported using the Standard Waste Transport Container (SWTC). It would be necessary for a purpose designed stillage to be provided to facilitate the handling and location of drums within the transport container. Assessments of gas generation from corrosion of encapsulated wastes indicates that the rate of hydrogen generation from the corrosion of the Magnox top-end fittings will be low and not lead to pressurisation of the transport container. This is based on experience gained from experimental work and actual gas measurements on packages of grouted Magnox FED at Trawsfynydd.

The assessment of operational safety showed that it should be possible for both types of Sizewell A MAC waste package to be handled and stored safely within a repository design concept based on the PGRC. However, the corrosion performance of the DCI drums over the potential 100 year interim storage period at Sizewell A, and potential extended storage period in the repository, remains uncertain. This issue may preclude transport and disposal of the bare DCI drum. No issues were raised with the disposability of the DCI drum overpacked in a 3m³ Box.

The post-closure safety assessment revealed no significant areas of concern that should prejudice disposal of packages containing Sizewell A MAC waste.

In summary, the Assessment of Disposability has concluded that a Disposability Safety Case could ultimately be made for DCI drums containing Sizewell A MAC waste overpacked in 3m³ Boxes. Further work would be necessary to adequately demonstrate that bare DCI drums would maintain their integrity over the timescales considered in the operational safety assessment.

Requirements for Further Development Work

The following will need to be provided as part of any Interim stage packaging proposals for the Sizewell A MAC waste stream:

- Substantiation of the radionuclide inventory data, in particular, quantification of the amount of thermocouple wire present in the Sizewell A FED cells;
- Provision of further evidence to demonstrate that a wasteform of acceptable quality could be produced;
- Demonstration of controls to eliminate any free water from the cured waste product;
- Provision of detailed design drawings for the DCI drum and 3m³ Box overpack;
- Substantiation of the longevity case for DCI drums;
- Provision of a programme of Quality Management System activities relating to the Sizewell A MAC project;
- Provision of draft Waste Product Specification and Criticality Compliance Assurance Documents;
- Provision of a detailed data recording methodology.

The above points have been raised as a series of Action Points.

Use of the DCI Drum

Although the DCI drums are non-standard containers, their proposed use in this instance is judged by RWMD to be appropriate based on a number of site specific constraints which would make alternative container options less practicable. In particular, the proposal to use DCI drums for such a small volume of waste is considered to be a pragmatic solution even though this may be considered to be inefficient and more costly as a result of the reduced volume utilisation.

It should be noted that a disposability case has only been made for DCI drums overpacked inside standard 3m³ Boxes. Bare DCI drums have not been determined to be suitable for ultimate disposal in their own right due to uncertainties associated with evolution of the cast iron container over the extended periods which need to be considered. RWMD have identified alternative packaging options, such as an internally shielded 3m³ Box or use of a standard Industrial Package type container, which could also be considered.

Conclusions

The Conceptual stage proposals from Magnox South for the retrieval and packaging of Sizewell A MAC have been assessed.

The assessment has considered two potential packaging options for transport and disposal of the Sizewell A MAC: bare DCI drums and DCI drums overpacked within a 3m³ Box. The assessment concluded that only overpacked DCI drums would be expected to be consistent with disposal under the Phased Geological Repository Concept (PGRC) and can be endorsed at the Conceptual stage. Further work would be necessary to demonstrate that bare DCI drums could be disposable in their own right.

The consistency of the DCI drums contained in 3m³ Box overpacks with the PGRC has been demonstrated through the provision of an Assessment of Disposability (at this stage to be regarded as a draft of an eventual Disposability Safety Case).

A number of Action Points have been raised which will require to be addressed as part of any Interim stage proposals for the waste.