

## Harwell Sea Disposal Packages

### (Conceptual stage)

#### Summary of Assessment Report

Issue date of Assessment Report: 16 July 2008

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#### **Introduction**

UKAEA has sought Conceptual stage endorsement of proposals for the packaging of Harwell Sea Disposal Packages produced for the proposed 1982 sea disposal campaign that was, in the event, halted as a result of action by the National Union of Seamen. UKAEA propose to overpack the Harwell Sea Disposal Packages into either 3m<sup>3</sup> boxes or 2 metre Boxes.

This Assessment Report summarises the conclusions of the assessment by NDA Radioactive Waste Management Directorate (hereafter RWMD) of the Conceptual stage submission for Harwell Sea Disposal Packages. 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 based on the geological disposal concept. Further information on the Letter of Compliance process is available elsewhere<sup>1</sup>.

#### **Background**

UK disposal of solid radioactive wastes to the sea commenced in the late 1940's. This continued through to the early 1980's. In 1982, preparations were made for a UK campaign of sea disposals. This included manufacture of some ~2,500 sea disposal packages. However, action by the National Union of Seamen, supported by environmental pressure groups, ensured that the 1982 campaign was indefinitely postponed.

In 1983, the contracting parties to the London Dumping Convention adopted a voluntary moratorium on the disposal of all radioactive wastes at sea pending a review, by an independent panel of experts, of the relevant scientific technical considerations. This panel produced its report in 1985, but the contracting parties to the Convention concluded that additional scientific and technical assessments, and studies on the wider political, legal, economic and social aspects of radioactive waste dumping, were required. In 1993, the contracting parties to the Convention finally banned the dumping at sea of radioactive wastes.

From about 1982, until the ban was finally ratified, UKAEA prepared further Sea Disposal Packages for deep sea disposal. In addition to those Sea Disposal Packages containing radioactive wastes generated at Harwell, Sea Disposal Packages were also prepared containing wastes from other sites, e.g. Dounreay, Winfrith, Sellafield, Amersham, Aldermaston, Chapelcross, Rosyth and Chatham. While some of these Sea Disposal Packages have subsequently been subject to further sentencing or treatment (some as LLW), the majority remain in storage at Harwell, awaiting final disposal. The sea disposal packages considered are those designated with design numbers 1801, 1802, 1803 and 1804. In addition to the four different sizes, the internal configuration of the Sea Disposal Packages were further categorised according to the layouts identified as Types A, C, D and E.

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

The UKAEA packaging proposals are based on over-packing the Sea Disposal Packages into standard ILW containers. UKAEA proposes to minimise the voidage inside the inner containers in the Sea Disposal Packages by introducing a suitable encapsulation matrix. UKAEA proposes to do this by drilling two holes into each Sea Disposal Package in appropriate locations, then injecting the immobilising medium. The UKAEA preference is to use an inorganic cement grout, but an organic polymer could be used if necessary; vinyl ester styrene and epoxy resin are being considered by UKAEA.

UKAEA proposes to over-pack the vast majority (2,054 out of 2,130) of the Sea Disposal Packages into the corner-lifting variant of the 3m<sup>3</sup> Boxes (depending on the size of the Package, 3, 4 or 5 packages will be overpacked into a single 3m<sup>3</sup> Box). The exceptions are the type 1804 Sea Disposal Packages, which UKAEA believes would not fit into the 3m<sup>3</sup> Box. UKAEA proposes to over-pack all bar one of these (75 out of 2,130) into 2 metre Boxes. UKAEA has stated that one of the type 1804 Sea Disposal Packages would not be suitable for over-packing in a 2 metre Box due to its fissile material content; UKAEA has suggested that this single Sea Disposal Package could be over-packed into a 3m<sup>3</sup> Box if the end were sawed off.

UKAEA has indicated that furniture would be used to locate the Sea Disposal Packages within their over-packs, ensuring that the Sea Disposal Packages did not damage the over-pack walls and that a controlled minimum thickness of infill grout was present between the Sea Disposal Packages and the over-pack walls. UKAEA proposes to infill the over-packs with a 3:1 PFA/OPC grout.

### ***Nature of the Waste***

The waste is diverse and includes a broad range of materials and items. It has arisen from operations undertaken by UKAEA, Ministry of Defence (MoD) and British Nuclear Fuels Ltd. (BNFL; now Sellafield Ltd.) at Harwell, Winfrith, Dounreay, Aldermaston, Rosyth, Chapelcross and Sellafield. Wastes produced by GE Healthcare and at MoD's Chatham site are expected to be consigned to the LLWR, although some GE Healthcare drums may be reassigned to the Harwell Sea Disposal Package waste stream.

The submission and supporting documentation identify the wastes to consist of a wide range of materials including steels, PVC, polyethylene, aluminium, rubber and cellulose. The materials are present in a wide range of items/forms including unimmobilised fines, cemented monoliths, sheets, tubes, pipes, sealed sources, watches, weights, pellets, filters, ion exchange columns and bags. The sea disposal drums themselves make a substantial contribution to the waste, and comprise steel and concrete.

### ***Scope of the proposals***

It is possible that some of the Harwell Sea Disposal Packages would be processed by GE Healthcare in their Harwell plant. It is also possible that 75 drums originating from the MoD would be consigned as LLW. The scope of this assessment includes these drums, but it is recognised that they may not require disposal as ILW. The scope of this assessment therefore includes all wastes in waste streams 5C08 and 5G10, which have a total volume of 865.3 m<sup>3</sup> (including the sea disposal package "carcass" and including the wastes that may be processed by GE Healthcare in the 2007 National Inventory).

This report represents RWMD advice on the disposability of the proposed waste packages based upon the standards and specifications developed from the geological disposal concept. In producing the Assessment of Disposability, due consideration has been given to safety and environmental protection requirements for transport, handling and disposal of the waste. RWMD expects the assessment of disposability could contribute to the licensee's Radioactive Waste Management Case as required by regulatory guidance, and specifically to the reasoned judgement that the conditioned waste will meet the anticipated requirements for acceptance from the potential disposal site operator.

It is suggested that the proposals be considered as HIGH priority under the current regulatory prioritisation scheme<sup>2</sup>. The principal reasons for this judgement are listed below:

- The proposal to inject an encapsulant into the Sea Disposal Packages is relatively novel
- Some packages are likely to contain sufficient quantities of reactive metals and/or PVC to require detailed consideration
- There is significant characterisation uncertainty.

### ***Technical Evaluation***

The Assessment of Disposability is based upon a set of radionuclide inventories supplied by UKAEA. RWMD has invested considerable effort to understand the basis of the waste package inventories presented in the submission document. The RWMD review identified a number of shortcomings in the derivation of average and bounding package inventories. However, RWMD has not attempted to produce a revised set of data sheets for assessment purposes, by agreement with UKAEA.

At this Conceptual stage there is significant uncertainty about the material composition of the wastes, making an assessment of the potential wasteform performance very difficult. This wastestream is extremely heterogeneous with wastes from a number of sites and a number of processes. Additionally, some of the existing records are sparse and do not list the material compositions in any detail. UKAEA has therefore had to make a number of assumptions regarding the compositions of the drums. It is not possible (on the basis of current package records) to specify an average package content with any accuracy and impossible to declare a bounding package content.

It is likely that there will be some challenging waste packages, e.g. those containing significant quantities of reactive metals or organic wastes. It has therefore not been possible to undertake a thorough wasteform properties and performance assessment at this stage. For example, in order to estimate realistic gas generation rates (bulk gas and radioactive gases) from average or bounding packages, it is necessary to define average and bounding material compositions. The submission notes that the bounding package could contain almost 100% of steel, stainless steel, aluminium, cellulose, cemented sludges, sources, lead, polyethylene or PVC. The range of gas generation rates from these bounding packages is very significant. In order to provide sufficient confidence in the disposability of these wastes, UKAEA will be required to provide more information on the properties of the proposed wasteforms.

### ***Assessment of Disposability***

The acceptability of the proposed packages has been assessed against criteria established for the geological disposal concept and associated Generic Waste Package Specification.

The assessments of Transport Safety show that it would be possible for packages containing the average inventories of the Harwell Sea Disposal Package streams and the bounding inventory Max A (the five highest type 1801 packages) to comply with all relevant criteria if transported in 285 mm thick walled Type B transport containers, although no calculation has yet been made of the potential neutron dose rates from the packages. There is some concern that some items have an associated dose rate that may be sufficient to exceed limits. It may be possible to show that the Sea Disposal Packages whose contents are known can be packaged, without special measures, to yield adequate dose rates. It must also be recognised that where there is a low confidence in existing records, there may be a

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<sup>2</sup> *The Management of Radioactive Waste on Nuclear Licensed Sites – Part 1: The Regulatory Process*, Guidance from the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency to nuclear licensees, December 2007

need to do more to ensure that compliant packages are produced (gamma and neutron monitoring before overpacking etc).

The PuO (package containing drums containing O-grade Pu at 200g total) bounding inventory is not encompassed by the generic cases defined in the transport container Design Safety Report and the Contents Specification for the SWTC. It is therefore concluded that a package specific criticality assessment would be required.

An assessment of bulk gas release from the packages has not been assessed and would need to be considered when more information is available on the wasteform composition.

The assessments of operational safety show that it should be possible for Harwell Sea Disposal Packages to be handled and stored safely within a Geological Disposal Facility. The assessments indicate that, under certain accident conditions, doses would exceed the Basic Safety Objective but in all cases will be well within the Basic Safety Level.

The current conclusions are based on the assumption that the assumed release fraction values are a conservative representation of the performance of the packages. Further development of more realistic release fraction values therefore will be sought at the Interim stage. Nevertheless, consideration of the conservatism in the assessments and expected future revisions to methodologies and assumed parameters would be expected to reduce the assessed doses considerably. It is concluded that this provides robustness against any future revisions to risk or dose targets.

The average package and the bounding Max A and Max PuO packages would be encompassed within the generic criticality cases derived.

An assessment of gas release from the packages has not been assessed and would need to be considered when more information is available on the wasteform composition.

The post-closure safety assessment has revealed no significant areas of concern that should prejudice disposal of packages containing Harwell Sea Disposal Packages.

An assessment of bulk gas release from the packages has not been assessed and would need to be considered when more information is available on the wasteform composition. Additionally, an assessment of the implications of the presence of toxic materials will need to be undertaken when more information is available on the quantities and form of toxic materials present in the stream.

A sensitivity analysis of the conclusions of the disposability assessment has shown that the conclusions are very sensitive to challenges to the underlying assumptions regarding package inventory and waste composition. Without further information to support key assumptions regarding package inventory and waste composition, it is not possible to make a case to dispose of these wastes if packaged as proposed. If UKAEA presented more information on sub-streams within the waste stream (for example by grouping wastes with similar physical or chemical characteristics) then it may be possible to resolve the uncertainty around these issues.

### ***Requirements for further development work***

The Conceptual stage assessment by RWMD has been based upon a number of outline proposals for the packaging of Harwell Sea Disposal Packages. Further work should be undertaken to group the packages into appropriate sub-streams, with common wasteform properties. Without this work, it may prove impossible to identify a true bounding package which could be used to represent these wastes in a disposability assessment. Within this work it may be possible to provide endorsement for a number of the sub-streams using the current packaging proposal.

## ***Conclusions***

The Conceptual stage packaging proposal for Harwell Sea Disposal Packages has been assessed.

It has not been possible to endorse proposals for packaging these wastes as proposed. Without further information to support key assumptions regarding package inventory and waste composition, it is not possible to make a case to dispose of these wastes if packaged as proposed.

A number of Action Points have also been raised which will require to be addressed as part of any future Letter of Compliance proposals for the Harwell Sea Disposal Packages.