PROJECT ASSESSMENT REPORT 2011

Adapted from http://www.onr.org.uk/pars/2011/oldbury-7.pdf

Local Concerns Paragraph (Not part of the report)

Bradwell : Proposal for fuel element debris disposal by dissolving Intermediates Level Nuclear waste in nitric acid, flushing a resulting solution presumably essentially of magnesium nitrate into the Blackwater, and packaging undissolved material in designated containers. Diluted Magnesium Nitrate which is highly soluble is not of itself considered much of a health hazard. What is of concern is possible dissolved radioactive matter and the management of the residual radioactive matter that has not been dissolved, including possible mismanagement or accidental leakage into the Blackwater. This could permanently contaminate the sea or river bed. There is clearly a difference between reprocessing products being discharged into the Blackwater and the discharge of coolant water from a productive Nuclear Power Station.

End of Local Concerns Paragraph.

Office for Nuclear Regulation

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ONR-Div1-OLD-PAR-11/18

Assessment of Proposal to amend arrangements under LC35 with respect to the strategy for Fuel Element Debris management

PROJECT ASSESSMENT REPORT

EXECUTIVE SUMMARY

Permission requested

Magnox Limited, licensee of Oldbury Nuclear Power Station, has requested agreement from HSE Office for Nuclear Regulation (ONR) to a change in its strategy for the management of fuel element debris at the Oldbury site.

Background

Fuel element debris (FED) is cladding from around the spent fuel, which is made from an alloy of magnesium and aluminium, known as 'magnesium non-oxidising' (magnox) alloy, giving its name to the Magnox class of nuclear reactors.

The existing Oldbury strategy (dealt with under nuclear site licence condition 35) for FED management is that it is retrieved during preparation for the station to enter its 'care and maintenance' stage, followed by encapsulation within containers suitable for eventual

permanent disposal. The containers would be stored on site for an interim period until the Government's preferred solution, a 'geological disposal facility' (GDF) becomes available.

This proposal is for a change to the strategy, to dissolve FED within an acid solution, removing it from the rest of the spent fuel and waste. All residues, secondary wastes and non-Magnox alloy components would be encapsulated in containers suitable for eventual permanent disposal. The dissolved FED would be discharged to the environment, subject to reduction using radiochemicals and authorisation from the Environment Agency.

This proposal considers only the strategy for FED management, detailed design of the process and plant are not included at this time and will be developed nearer to the project implementation date. The proposal for implementation will take into account the dissolution experience from other Magnox sites. The process of dissolution, as with the processes associated with the current encapsulation strategy, would take place within the Oldbury licensed site.

Assessment and inspection work carried out by ONR in consideration of this request

ONR specialist inspectors in chemistry and waste management have undertaken a technical assessment of the submission, key supporting references and also confirmed

that the licensee has satisfactorily completed its due process. Confirmation that the Environment Agency offers no objections to this proposal was sought and verification of

this obtained from the Agency.

The specialist inspectors considered the advantages and disadvantages of the proposal including the waste hierarchy and the attainable volume reduction. As the proposal refers only to the strategy for FED waste, ONR will carry out a further detailed assessment in due course, as part of the planning and implementation of the project.

Matters arising from ONR's work

No issues or concerns were found during the assessment of the report or the associated references which required immediate resolution by the licensee. The assessment did identify a number of issues that would need to be addressed as part of the eventual assessment of the planning and implementation of the project.

Conclusions

The principle behind the submission is favourable with respect to the waste hierarchy (as defined in the Joint Guidance on the Management of Higher Activity Radioactive Wastes) and delivery of a significant hazard reduction in the longer term and is thus supported and accepted, but significant further work will be required before any move toward final

implementation of this proposal.

Recommendation

The Office for Nuclear Regulation agreed to the request from the licensee and issued

Licence Instrument No. 538 accordingly.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BMS	(Nuclear Directorate) Business Management System
BSL	Basic Safety level (in SAPs)
BSO	Basic Safety Objective (in SAPs)
EA	The Environment Agency
HSE	The Health and Safety Executive
IAEA	The International Atomic Energy Agency
NDA	Nuclear Decommissioning Authority
OCNS	Office for Civil Nuclear Security
ONR	Office for Nuclear Regulation
PCER	Pre-construction Environment Report
PCSR	Pre-construction Safety Report
PSA	Probabilistic Safety Assessment

PSR Preliminary Safety Report

RGP Relevant Good Practice

SAPs Safety Assessment Principles

SFAIRP So Far As Is Reasonably Practicable

SSC System, Structure and Component

TAG (ONR) Technical Assessment Guide

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1. INTRODUCTION

1.1 The fuel element debris (FED) stored at Oldbury consists mostly of Magnox metal (a magnesium/aluminium alloy) and swarf resulting from the de-splittering process used to prepare fuel for transport to Sellafield. The de-splittering operations commenced in 1969 and continue to the present day.

The process of de-splittering involves mechanically stripping the outer Magnox cooling fins and lugs, leaving the uranium fuel rod within the core of the fuel element. The resulting waste material comprises mainly MAGNOX alloy and fuel element end fittings. In addition to the Magnox debris (estimated at 99.9% of the Oldbury FED inventory by volume), the

waste contains higher activity parts in the form of nimonic springs, of which there are believed to be a number in excess of 100,000, predominantly stored in vaults 1, 2 & 4 at Oldbury. Additionally, the vaults contain thermocouple wires, end fitting components and

also, potentially, fragments of irradiated uranium metal arising from failures during the de-splittering process. Much of this additional and higher active material is generically referred to as Miscellaneous Activated Components (MAC). The FED will also contain a small volume of contaminated gravel, which resides at the bottom of the two earliest FED

vaults (vaults 1 and 2, roughly 4m3 at the base of each). This will contain small quantities of Magnox debris and MAC items. Although the FED and other debris has always been stored in a dry condition at Oldbury, some corrosion products may also be present in the older FED waste materials. These are considered to be surface corrosion products rather

than the sludge type products seen at other Magnox sites, however, the proposed process will be equally valid for the processing of wet and corroded Magnox FED.

Specific details of the nature of the waste are listed (source of arising, characteristics, inventory and quantities) in The 2007 UK Radioactive Waste Inventory. The volume of FED at Oldbury is estimated at 400m3 and an important driver behind this proposed change is that the majority of the radioactive inventory arises from the higher active nimonic springs etc. which are believed to comprise only about 0.5m of

the total volume of this inventory.

1.2 There are a total of five above-ground, dry storage vaults within the Active Waste Building (AWB) that house FED. Vaults one to four (which are all full) contain splitter debris from approximately 214,000 fuel elements. Vault five is still in use and expected to remain so until the end of de-fuelling operations, at which point debris from an estimated 50,000+ elements will have been deposited in the vault. It is anticipated that approximately 410m3 of FED waste will have accumulated in the AWB by the time the station ceases generation and has been defueled, making it the largest single volume of operational waste-stream Intermediate Level Wastes (ILW) on site.

1.3 The current LC35 strategy for management and disposal of this entire volume of waste involves immobilisation (cementation) within (ISO) containers suitable for eventual permanent disposal, the containers being stored on site for an interim period pending the Geological Disposal Facility (GDF) becoming available. This proposal seeks to change

this strategy to one whereby the waste is sorted by type and the Magnox (the bulk thereof) is dissolved by the action of an acid and the resulting liquid effluent treated before discharge to the Severn estuary under authorisation. With the vast majority of the activity

being retained either during sorting or by the insoluble nature of the materials concerned, the overall volume of ILW for disposal will be greatly reduced.

1.4 The liquid effluent produced by this process will be a salt of magnesium, the nature of which to be determined by the choice of acid to be used. Magnesium is already the third most abundant element in seawater and the liquid will be treated in order to meet authorised discharge limits.

Secondary wastes and the non Magnox components will then be processed by the currently planned solid ILW encapsulation plant. The current strategy for the site as a whole is expected to require in the region of 378 containers for the storage/disposal of ILW wastes, dissolution of the FED inventory is estimated to afford a reduction in the requirement for containers of 150, down to approximately 228 in total. The residues from the FED post-dissolution are estimated as requiring 10 containers[1]. This reduction in number of containers delivers an immediate reduction in the required capacity for the onsite ILW storage as well as downstream final disposal in a Geological Disposal Facility (GDF).

2. BASIS FOR DECISION

2.1 Station perceive the following benefits from the adoption of this change, as given at

Programme level:

The following main benefits, stated in the Programme Level Business Case for the FED Treatment Programme for Magnox North & South, will arise from adopting dissolution at Oldbury and three other Magnox sites:

1. Volume reduction of up to 90% can be achieved through dissolution of magnox FED Intermediate Level Waste offering significant cost reductions to the waste management programme in the current Lifetime Plan (c£102M reduction in the Nuclear Liability Estimate for Bradwell, Hinkley Point A, Sizewell A and Oldbury).

2. Significant reduction in Oldbury site lifetime costs and the Nuclear Liability Estimate (c£26M for Oldbury).

3. Reduction of funding profile in the near and long term across the four sites, allowing the potential release of funding to fund hazard reduction in other areas.

4. Environmental benefits include: consistency with the Waste Hierarchy;

5. Reduction in secondary waste; reduction in overall waste volume to the Low Level Waste Repository (LLWR) and the national GDF (150 fewer containers of ILW produced at Oldbury, approx 40% of total); lower carbon footprint due to reduced concrete requirement for interim stores; and reduction in transport.

6. LC35 regulatory milestones are met – the FED dissolution programme is based around achieving the LC35 milestones at all four sites.

7. By managing the overall dissolution programme to the LC35 milestone dates, the business will be able to optimise the project affordability and Nuclear Decommissioning Authority (NDA) can maximise the benefits from re-use of project resources and application of lessons learned as sub-projects progress. This achieves the NDA Strategic Objective (SO15) of 'All ILW in packaged form and arrangements for minimal buffer in place' and assists in getting the Magnox Reactors into Care and Maintenance (SO5).

2.2 In addition, the following disbenefits are cited :

1. Requires a small plant to be installed that can only be used for processing FED.

2. Handling and storage of process chemicals for use in the dissolution plant.

3. Radioactive secondary wastes (possibly ILW) from discharge abatement.

4. Between 40-50 cubic metres of low active effluent discharge every 3 full days of operation, equating to about 6000 cubic metres of additional liquid discharge/yr and thus representing a significant annual increase. Total activity arisings from entire dissolution programme predicted at approx 3GBq of Tritium and 40GBq of Caesium 137. This compares with, current annual site aqueous arisings of approx 7800 cubic metres , containing approx 156 GBq Tritium; 200GBq Caesium 137 and 90GBq of other radionuclides. Magnox material contains some trace levels of 'black' and 'grey' listed chemicals under Water Resources Act (Cadmium, Silver, Beryllium, Boron, Copper, Nickel, Lead, Thorium, Uranium, Zinc), although abatement may remove these from discharges.

2.3 During their optioneering phase the licensee has considered and scored a number of routes for FED ILW, the dissolution scoring highest over deferred retrieval and packaging by a narrow margin, both of these options winning over the current LC35 strategy option of near-term retrieval and packaging.

2.4 The lack of a firm position on the choice of acid for the dissolution of the FED lies with the current dual programmes being progressed elsewhere, carbonic acid at Dungeness A and (proposed) nitric acid at Bradwell.

2.5 The licensee has considered the environmental impact of this proposal per their arrangement under the Environmental Impact Assessment for Decommissioning Regulations (EIADR99) and have assessed the technology readiness level (although

coloured by the formative status of the nitric dissolution at Bradwell) as adequate and

continuing to improve with the experience of the two lead sites and their respective approaches.

2.6 Although no Letter Of Compliance (LOC) from the Radioactive Waste Management Directorate regarding disposal under the current (cementation / encapsulation) strategy has been sought, a conceptual LOC (cLOC) has been obtained elsewhere (Trawsfynydd) under a similar strategy and the licensee does not consider this problematic. The licensee

also does not consider it unreasonable for cLOC's to be obtained for the various different arisings to be produced from a dissolution process such as nimonic parts, sludges and ion exchange resins, to be obtained at the implementation stage as these materials already arise from elsewhere in the programme.

2.7 Acceptability for final disposal is considered only briefly in the submission. ONR would carry out separate assessment of detailed requirements once the facility designs are under way and the details of the nature etc. of the secondary wastes are fixed.

3. WORK FORMING THE ASSESSMENT

3.1 Aspects of the following SAPS and procedures were considered in forming this assessment.

RW.1 Radioactive Waste Management – Strategies for Radioactive waste

RW.4 Radioactive Waste Management – Characterisation and segregation

RW.5 Radioactive Waste Management – Radioactive waste should be stored in accordance with good engineering practice and in a passively safe condition

T/INS/035 Site Inspection and Enforcement Guidance: LC35 Decommissioning, Issue 002, June 2005;

T/AST/024 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites, Issue 003, March 2001

The management of higher activity radioactive waste on nuclear licensed sites, Part 2

Radioactive Waste Management Cases, Part 3a Waste Minimisation, Segregation and Characterisation (February 2010) and Part 3b Conditioning and Disposability (trial use, February 2010).

3.2 The current proposal from the licensee presents only a proposed strategy change and lacks specific details concerning the mechanism for the dissolution and the subsequent treatments and disposals of the various arisings. The provision of detailed information is

deferred until a time nearer the proposed implementation and significantly more developed proposals will be required to enable assessment prior to any implementation of the proposed strategy at that time.

3.3 The licensee has conducted a study of available options and its finding is that the dissolution option is preferred on both waste minimisation and economic terms, while remaining competitive with other options in terms of risk of dose to the public and/or operators. The case to date continues to state that work will be required to fully optimise the working practices to ensure the ALARP dose criteria are delivered during the process.

3.4 Operational experience of FED dissolution is limited as although live proposals are progressing elsewhere the only operational experience (OPEX) basis is that of Dungeness which has undertaken FED dissolution using carbonic acid for some time and hence ONR has some limited knowledge of this programme. This has worked well but is a slow

process. The next most relevant programme is that proposed for Bradwell where nitric acid is the proposed dissolution media, this case is being developed currently and is subject to regulatory approval.

3.5 The waste management aspects of the safety case have been assessed by |||| |||||||||||| |||||||||| [2] and the chemistry aspects assessed by ||||| ||||||||| |||||||||||||[6]. While a number of issues have been identified, the shortfalls do not provide any technical showstoppers or

areas where radioactive waste management principles are compromised and hence no grounds for recommending refusal of the proposed LC35 strategy change.

3.6 In accordance with the ONR BMS and relevant Environment Agency MOU the views of the Agency were sought and a response from the EA Site Inspector for Oldbury confirms that EA have had cognisance of this proposal and offer no objections to the

proposed strategy change.[3]

4. CONCLUSIONS

4.1 The precise change requested is a change in the wording of the strategy;

From:

"The strategy for FED is retrieval during Care & Maintenance Preparations (C&M Preps) and encapsulation: This involves immobilising the waste by encapsulation within containers suitable for eventual permanent disposal. The containers will be stored on site for an interim period pending the Geological Disposal Facility (GDF) becoming vailable."

To:

"The strategy for FED is retrieval during C&M Preps and dissolution: This involves dissolving the magnox metal within an acid solution with the bulk of the radioactivity retained within the residue and secondary wastes. The residue, secondary wastes and non magnox components are to be encapsulated in containers suitable for eventual and

permanent disposal. The containers will be stored on site for an interim period pending the GDF becoming available."

4.2 The strategy change being sought in the submission is from FED encapsulation to FED dissolution (using an as yet unspecified acid solution). The general case for dissolution results in a potential significant reduction in the overall volume of waste and this aligns with the waste hierarchy[5] and accepted. Carbonic acid dissolution is a technically viable and well-developed option as demonstrated by its successful implementation at Dungeness A. At this time it is not accepted that the use of alternative acid solutions, such as the stated example of nitric acid, are as well developed. Whilst the

desire to build in flexibility with respect to the final choice of acid solution is understood, the case for this is not demonstrated at this time. This will be assessed once the plant modification is developed and is not a critical item regarding the proposed strategy change.

4.3 The benefits stated in the submission's conclusions of reduced environmental impacts, accelerated hazard reduction and increased flexibility to adopt opportunities for more favourable waste management solutions have not yet been well substantiated, however,

their inclusion does not impact the assessment. The primary hazard reduction and waste hierarchy[5] gain from the significant decrease in waste volume is key to this proposal, yet considered only briefly among the benefits and not developed further.

4.4 The BPEO study (summarised as part of the submission) and the ALARP assessment that support the proposed strategy change with respect to the definition of options are also not yet well developed but again are not critical items regarding the proposed strategy change.

4.6 The absence of final or conceptual letters of compliance for the ILW arisings from dissolution is assessed only as a minor concern in this proposal as such approvals have been obtained elsewhere. Inclusion of information to this effect would have strengthened this proposal but its omission has not affected the assessment outcome.

4.7 Overall, the principle behind the submission is very favourable with respect to the waste hierarchy[5] and will deliver a very significant hazard reduction in the longer term and is thus supported and accepted, but significant further work will be required before any

move toward final implementation of this proposal. This report therefore represents permissioning of the strategy only and facilitates development of process & equipment by Magnox. It does not allow for deployment of the strategy which would require separate assessment and Permissioning under licence condition 22.

4.8 As part of our regulation of the accumulation of radioactive wastes we seek to establish disposability through engagement with EA and the use of the letter of compliance process. While there are no conceptual letters of compliance in place at this time this is not seen as a barrier to the Office for Nuclear Regulation agreeing to the strategy change

as there is time for this aspect to be developed in advance of any equipment development or deployment.

5. RECOMMENDATIONS

5.1 That the Superintending Inspector should sign this PAR and associated Licence Instrument LI538 in support of the proposed (LC35 Decommissioning Programme) strategy change.

5.2 |||| |||||||||||| to write to the licensee listing the waste management issues which will need to be addressed before the ONR can agree to final implementation of this strategy.

6. REFERENCES

1. 2010/513970 NP/SC 5064: Proposal to Revise LC35 Decommissioning Programme in Respect to the Strategy for the Management of Fuel Element Debris

2. 2011/228274 Radwaste technical assessment of NP/SC 5064: Proposal to Revise LC35 Decommissioning Programme in Respect to the Strategy for the Management of Fuel Element Debris. |||||||||||| |||.

3. 2011/156601 email @ 18/03/2011 {|||||||||||||||||||||||||||||||||||||||||||||||||} EA response to

proposal.

4. ONR Business Management System

5. Joint Guidance on the Management of Higher Activity Wastes on Nuclear Licensed Sites HSE/EA/SEPA, February 2010.

6. 2011/235805 Assessment note: Chemistry assessment of NP/SC5064 Iss2.

7. REPORT DATA

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Oldbury refers to Oldbury-on-Severn