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**HEALTH AND SAFETY EXECUTIVE
NUCLEAR SAFETY ADVISORY COMMITTEE
REVIEW GROUP 6**

22 APRIL 2008

2008/9 PROGRAMME OF WASTE AND DECOMMISSIONING RESEARCH

Paper by Magnox Electric Ltd

BACKGROUND

- 1 Magnox Electric Ltd is a Site Licence Company (SLC) currently owned by the Nuclear Decommissioning Authority's Management & Operations contractor, Energy Solutions. Magnox Electric Ltd is the SLC for ten sites, consisting of all of the UK Magnox power station sites except for Calder Hall.
- 2 At present, Magnox Electric remains the single licensee for all ten sites but since October 2007, the two regions have operated independently for a period of formal 'Shadow Working' in order to demonstrate capability and processes, followed by legal separation and the formation of new SLCs during 2008 – Magnox North Limited and Magnox South Limited.
- 3 Magnox North and Magnox South have separate, but complementary, Research and Development (R&D) programmes. To ensure efficient realisation of the R&D projects, since there is substantial overlap between the R&D needs of both North and South, there is co-ordination of the waste and decommissioning R&D. As discussed in more detail later, the majority of the baseline underpinning R&D is carried out by Magnox North, while Magnox South leads, through the Decommissioning Strategy Organisation (DSO), R&D that could ultimately underpin any future decision to change and improve the baseline technology. This relationship is not unique, with significant sharing and co-operation on R&D occurring with other licensees increasingly co-ordinated through groups such as the Nuclear Waste Research Forum (NWRP), see Paragraph 8.
- 4 Since 2006/07 it was agreed with the NII that the previous research arrangements relevant to large generating site licence companies are no longer relevant to Magnox Electric and these arrangements have been

terminated. Both Magnox North and Magnox South now ensure that waste and decommissioning R&D meet the needs of the “NSD Research Strategy Statement for Decommissioning – Licensees 2007”. The NDA also requires that R&D needs are identified so as to demonstrate that the Technical Baseline is secure through to Final Site Clearance. This is demonstrated via a document known as the Technical Baseline and underpinning Research & Development (TBUrd). This document details the technology risks, needs and opportunities in a transparent and auditable manner. Each Magnox North and Magnox South Site is required to publish a TBUrd document.

- 5 Each Site has identified those projects that need to be undertaken in 2008/09 to underpin the technical baselines and/or directly address areas of regulatory concern (e.g. from Reference [1]). This paper provides a brief summary of the generic R&D projects planned for realisation during 2008/09. It should be noted that, at the time of writing, the planning process was not finalised and some changes may be required. Further, each site commissions their own waste and decommissioning R&D where the need is site specific; this most usually occurs during the commissioning stages of plant and is more focussed on ‘development’.

RESEARCH STRATEGY

- 6 The Magnox Electric Ltd research strategy continues to be influenced strongly by the ongoing programme of cessation of generation of the Magnox stations. Magnox North will, however, continue to undertake all reasonably practicable research to support generation-related safety cases.
- 7 For example there is still a significant programme of graphite-related and control and instrumentation-related research which continues to underpin the operational safety cases at both Oldbury and Wylfa. Both are still generating electricity with Oldbury due to cease generation later in 2008 and Wylfa during 2010, and both are managed within Magnox North. It should be noted that, despite this ongoing reduction in generation-related research activity, the existing Quality Management System will ensure that all staff engaged on work related to nuclear safety, such as the production of safety cases, will continue to be suitably qualified and experienced persons (SQEP) as required by Site Licence Condition 12. Decommissioning topics remain the largest single technical area for research funds and this can be expected to remain the case in the future. This paper deals only with waste and decommissioning R&D.

TECHNICAL EXCHANGES

- 8 R&D Technical Exchanges between Magnox North, Magnox South, NDA, regulators, other SLCs and other stakeholders now take place under the NWRF, which meets quarterly and formally reports to the NDA Research Board. The NWRF is currently chaired by Magnox South and secretariat provided by Magnox North. Links have been established with recognised

expert groups in identified areas both from within the nuclear industry and from a wider basis.

- 9 The planned Magnox North and Magnox South R&D is subject to continued internal review and challenge at the Reactor Waste and Decommissioning Technology Group (RWDTG), which consists of all the SLCs, and the overarching NWRF. This assures that the projects are focussed on delivering fit-for-purpose output to meet the needs presented in the TBUrDs from the 'bottom-up' while meeting the requirements of the NSD Strategy Statement and other regulatory needs.

FUTURE DEVELOPMENTS

- 10 2007/8 has seen a period of further significant change within the UK nuclear industry and it seems certain that this will continue during 2008/9. However, despite these changes, the safety-related responsibilities of the site licensee remain largely as before. Research will continue to be undertaken where this is judged to be reasonably practicable.
- 11 It is likely that a significant proportion of the research required to support the decommissioning sites will be of relevance to several, if not all of the future NDA licensees, and that a framework will be required to ensure this work is delivered in an efficient manner that does not involve duplication of projects. For example, the NWRF is seeking to establish sub-groups to improve co-ordination of R&D activities in specific areas of waste & decommissioning of common interest, these include: mobile ILW, decontamination, and high-temperature processes. Establishing an effective and open communications research framework, involving multiple stakeholders, within the anticipated competitive environment is still the goal sought by the NDA.
- 12 During 2007/08 the NDA requested that Magnox North and Magnox South sites identify and analyse strategic options for defining Safe and Secure Sites (S³). The S³ programme will provide alternative contingency plans to the current Lifetime Plans for Magnox sites, in the context of NDA's aspiration to allocate future funding on the basis of hazard reduction priorities across the NDA sites. The S³ programme is expected to run for at least 12 months. All options explored will be assessed against a range of criteria, in particular our commitment to the highest standards in health, safety, security and environmental performance.

SUMMARY OF THE MAGNOX NORTH RESEARCH PROGRAMME

- 13 ⇒ ⇐ Outline descriptions of the Magnox North research programme are provided in Table 1. A total of 25 generic projects are listed and these will contribute to underpinning of the Magnox sites' technical baselines. The projects cover a variety of areas with considerable overlap into the areas highlighted in the NSD Research Strategy Statement for Decommissioning [1]. Three long-term Magnox North projects are co-funded by British Energy.

- 14 The majority of the projects in Table 1 derive directly from the needs presented in the Magnox North TBUrd documents. Each Magnox North site has contributed to the R&D project development through a consultation programme. Each Magnox South site was invited to contribute to project development. The views of Magnox South have been incorporated, without prejudice to the Magnox North project requirements as they are fully complementary.
- 15 While the funding and resourcing environment remains challenging the expectation is that the 25 projects will be completed by a combination of external funding (contractors) and self-performing using internal SQEP staff. Opportunities to train staff in 'shortage' technical areas, by shadowing more experienced staff, will be exploited where appropriate.

SUMMARY OF THE MAGNOX SOUTH RESEARCH PROGRAMME

- 16 ⇒ ⇐ Outline descriptions of the Magnox South research programme are provided in Table 2. A total of 12 generic projects are listed and these will help underpin the Magnox sites' technical baselines. The projects all derive from the 2007/08 programme and relate to non-essential work that could not be completed due to funding cuts. The majority of the projects relate to knowledge management activities and collation of existing information generated, in part, from previous years' Magnox-related R&D.
- 17 The projects cover a variety of areas with considerable overlap into the areas highlighted in the NSD Research Strategy Statement for Decommissioning [1].
- 18 While the funding and resourcing environment remains challenging the expectation is that the 12 projects will be completed by a combination of external funding (contractors) and self-performing using internal SQEP staff.
- 19 Magnox South also sponsors the DSO's work in a number of technical areas. This work may be used in the future to justify the decision to change waste and decommissioning baselines. The primary role of the DSO is to develop and optimise waste management and decommissioning strategies. It is recognised that existing strategies may not be optimum solutions and may not provide the best value for the Customer. This work is shared and complementary to the work of Magnox North and other licensees. It covers "opportunity" work in the following areas:
 - Wet Waste disposition
 - Desiccant Disposition
 - IONSIV Disposition
 - Integrated FED Solutions (including dissolution)
 - On-site Disposal of Low Hazard Waste
 - Contaminated Metals Disposition
 - ILW Store Optimisation
 - Transport of FED and Wet Waste

- Waste Management & Characterisation
- Integrated Waste Strategy (IWS) and Inventories Management.

CONCLUSIONS

20 It may be concluded that:

- Both Magnox North and Magnox South, currently in a period of Shadow Working, continue to recognise the requirement to undertake all reasonably practicable nuclear safety-related research.
- The 2008/09 projects aim to provide an adequate and balanced programme that continues to reflect the transition from generation to decommissioning.
- While formally Shadow Working, Magnox North and Magnox South continue to share and complement each others' R&D needs – in common with the other licensees through the NWRF and RWDTG.

ACTION REQUIRED

21 RG6 is invited to note and comment on the paper.

REFERENCES

1. NSD Research Strategy Statement for Decommissioning - Licensees 2007.

Table 1 Magnox North 2008/9 Waste & Decommissioning Research and Development Programme

Project Number	Descriptive Title	⇒
1	Deposition of Wastes Requiring Additional Treatment (WRATs) and suspected orphans. Small volume waste streams have been identified and the project will determine if they are true orphan wastes and investigate the best practice for management and/or waste disposal. Includes wastes such as zinc bromide, tank/silo residues, zeolite skips etc.	
2	Sorption systems for immobilisation of contaminated oils and problem liquid wastes. Several systems were identified in 2007/08 that could be used to stabilize liquid wastes. Further work in 2008/09 will assess the systems identified and decide which are suitable for further experimental investigation. Work will also be carried out to assess the complementary use of sorption systems for transport followed by incineration.	
3	Magnox ILW storage guidance. This project will update the existing guidance document by taking account of a formal review and recent developments.	
4	Contaminated gravel treatment. This work will assess the technical viability of decontaminating silo gravel by a chemical dissolution process and whether the product is compatible with cementitious grout. Included are also low-risk materials that are not likely to present significant challenge to the baseline cementation technology and this needs to be demonstrated.	
5	Development of systems for ⁷⁹Se and ⁹⁹Tc analysis in ILW. The purpose is the design, development, realisation and delivery of analytical techniques and methodologies for ⁷⁹ Se and ⁹⁹ Tc which will allow accurate determination of these radionuclides in specified waste streams.	
6	The disposal and long-term management of sources. The management of radioactive sources and confirmation of disposal routes.	
7*	Long-term monitoring cemented wastes. Continuing programme of monitoring of cemented waste simulant samples to underpin LoC submissions (and their revalidation).	
8	Application of MAGGAS model to cemented wastes. Continued computer modelling of gas generation from ILW packages. This will be used to underpin LoCs and ILW store ventilation requirements.	
9*	Corrosion assessment of containers of cemented wastes. Continuing programme of monitoring of instrumented containers of cemented wastes to underpin LoCs.	
10*	Gamma irradiation of samples of cemented waste. Continued γ -irradiation and monitoring programme of cemented samples to underpin LoCs.	
11	Grout enclosure techniques. A requirement has been identified	

Project Number	Descriptive Title	⇒
	for the need to develop a suitable inner container, grout and characterisation techniques to condition desiccant containing tritium and other similar wastes safely.	
12	Security of supply of strategic materials used to encapsulate and contain ILW. The project is to carry out an annual review of the report prepared during 2007/08 and incorporate minor updates. This gives early warning of emergent security and supply issues and allow for mitigation strategies to be put in place. An expert workshop is planned to determine a close-out strategy.	
13	Testing of long term integrity of building cladding panels under UK severe weather exposure. The project, which has been running for about 40 years, will continue the detailed annual examination with photographs and report on the 20 samples of cladding. Some remediation work may be required.	
14	Monitoring, selection and storage of reactor archive samples including steels, graphite and construction materials. This project will progress delivery of the recommendations made in the report delivered during 2007/08 as part of the NWRf sub-group.	
15	Comb superplasticisers. During 2007/08 irradiation trials of comb superplasticisers were carried out. This project will close out the work through detailed analysis of the decay and degradation products. This will help determine whether these materials can be deployed to optimise ILW encapsulation.	
16	Radiochemical analysis. This project will continue the review of future needs for radiochemical analysis against potential supply limitations. This will expand the earlier work and ascertain alternative strategies into a more robust format.	
17	Reworking and package longevity. This project will assess techniques to monitor and mitigate the aging processes that occur in prolonged storage. This will include identification of out-of-specification and non-compliant packages, remediation requirements; and the identification and management of any high risk packages.	
18	Decontamination techniques. This work will look at the safe dismantling and decontamination of non-activated structural components of reactor and chemical plant. It will look to test the feasibility of relevant techniques, e.g. microwave scabbling, ice pigging and the application of high pressure washing design.	
19	Fault conditions – transport and movements. This project will build on previous work and address whether a dummy container can be made to monitor the impacts during realistic transport and store movements. The significance, if any of metal-grout debonding will be investigated.	
20	Effluent treatment. This project will provide further work on the assessment of Mobile Active Effluent Treatment Plant (MAETP) and current best practice in this technical area.	
21	Human factors. This work will seek to address gaps identified	

Project Number	Descriptive Title	⇒
	from previous work where there are valid R&D requirements in human factors applications.	
22	Contaminated land – membership and participation at SAFEGROUNDS and SAGTA	
23	Knowledge management and technical exchange activities in support of the waste and decommissioning eRoom	
24	Subscription to waste and decommissioning journals to support intelligent customer and design authority capability	
25	Attendance at waste and decommissioning conferences	⇐

* Co-funded by British Energy.

Table 2 Magnox South 2008/9 Waste & Decommissioning Research and Development Programme

Project Number	Title	⇒
1	Particulate science of magnesium hydroxide based materials in support of Magnox wet waste processing. Previous work has been carried out for a PhD project. The conclusions will be evaluated against other waste processing technologies and a determination made as to further work required.	
2	Position statement on design and operational concepts for Magnox ILW stores. The design and operational concepts for ILW stores should be similar and based on a common database (steel corrosion rates, known environmental conditions, gas-release rates etc). The project will continue to review the use of standardised store operating conditions and parameters based on existing and proven store designs.	
3	The behaviour of magnesium-hydroxide colloids in ponds wet wastes, e.g. filtration (SCRU), mobile AETP, MXD. This project depends on the outcome of other project work	
4	Preparation of supporting documentation for waste treatment. Due to be completed in 07/08. The project is intended to cover the issue of compendium documents of cement formulations, waste simulants and a bibliography relevant to waste immobilisation. Any identified additional work but may be superseded by an NDA Knowledge Management process proposal.	
5	Lifetime model for external corrosion of ILW containers. This work will model the internal and external corrosion of ILW packages from encapsulation of waste through to an appropriate date within the repository. This will include package movement and the implications for the inspection regime. One objective is to develop the concept of an on-going residual life of a waste package.	
6	Review of alternative container materials. The project will compile a list of alternative container materials including copper	

Project Number	Title	⇒
	alloys, titanium alloys, nickel alloys, super-austenitic, super-duplex, composites and high-strength concretes that might be applicable to Magnox wastes.	
7	Options for removal of reactor graphite installed sets (core moderator samples) during decommissioning. The project will continue to identify the status and availability of reactor graphite sets (core moderator samples) on all Magnox sites and where possible, identify the physical properties and in-core history of the samples, e.g. dose, calculated mass loss and porosity. The feasibility and timescales for retrieval shall be identified including the expected availability of the refuelling machine.	
8	Approaches to determine the radionuclide concentrations in ILW streams. In support of LoC Assessments and BPEO studies the project is to continue work in the collection, assimilation and clear presentation of existing information on the determination of radionuclide concentrations in ILW streams.	
9	Handbook of the processing and immobilisation of organic IX resin wastes. A handbook for the processing and immobilisation of Magnox IX resin will provide a comprehensive listing of all aspects of potential options for the treatment and packaging of all Magnox ILW and LLW IX resins.	
10	Handbook of the processing and immobilisation of Magnox Fuel Element Debris (FED). A handbook for the processing and immobilisation of Magnox fuel element debris (FED) will provide a comprehensive listing of all aspects of potential options for the treatment and packaging all Magnox FED and magnesium based waste materials, e.g. pond sludge.	
11	Handbook of the processing and immobilisation of desiccant waste. A handbook for the processing and immobilisation of Magnox ILW desiccant will provide a comprehensive listing of all aspects of potential options for the treatment and packaging of all Magnox desiccant materials such as activated alumina, molecular sieve (such as aluminosilicates) and silica gel.	
12	Review and search for unidentified samples in storage. The project objectives are to: provide assurance that there are no uncosted liabilities and locate potentially valuable forgotten samples as long-term test samples for additional R&D studies.	⇐

⇒ *This information has been removed under Exemption 13 of the Code of Practice on Access to Government Information (commercial confidentiality)* ⇐