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WASTE AND DECOMMISSIONING
Scope

This generic extended Strategy Statement has been written to (i) facilitate appropriate R&D on radioactive waste and decommissioning by all of the UK's nuclear Licensees, (ii) to make sure that HSE's own needs and concerns in the Waste and Decommissioning technical area have been considered in the preparation of their updated Technical Baseline and Underpinning R&D Needs documents (TBURDs) for the NDA and the 2009-10 Nuclear Safety Research Schedules from British Energy.

This strategy statement is not intended to prescribe what research a licensee will undertake in any one year but instead lists the topics where ND believes that R&D will be needed to support the safety cases each licensee will need to make to enable its lifecycle baseline to be met. Each licensee should develop its 2009-10 research programme from a consideration of where it is on the decommissioning lifecycle and the timescales required to complete the necessary research, so that future operations can be permissioned in a timely manner.

The scope of this statement applies equally to operating power reactors, chemical plants and plant undergoing decommissioning. The research strategy set out below is based upon the Index of Technical Issues that was developed at a workshop in November 2004, facilitated by Quintessa. In addition to the technical issues identified at this workshop, the ability of a Licensee to make adequate safety cases for waste management and decommissioning operations requires up to date competence in a number of supporting disciplines such as Human Factors, Control & Instrumentation, PSA and Fault Studies. Decommissioning operations could also give rise to specific research needs in these areas.

Research in these support areas may be managed through the appropriate technical area in the Nuclear Research Index (NRI) for operating power plant and the Sellafield Research Strategy Statements under the Sellafield Nuclear Safety research arrangements, for fuel cycle plant. These support areas are included in the list below for completeness and the benefit of the decommissioning licensees.

Equally, it is recognised that a licensee with operating plant may not pursue all of the Quintessa Technical Issues identified below under the 'waste and decommissioning' heading but may instead choose to cover some Issues such as waste retrieval, treatment and passivation and effluent control, under the programme for another technical area such as process technology.

Regulatory challenges

R&D issues covered in the field of waste and decommissioning differ in some ways from those addressed in other areas. In most fields the issues identified are directly concerned with the safety of reactor or chemical plant in the comparatively short term (essentially during their remaining operational lifetime). Because of the long-term nature of waste and decommissioning issues, Much of the R&D required is not readily associated with safety in the short term, though in general there will be an underlying safety-related driver; waste retrieval and treatment to convert it to a passively safe and immobile state will contribute to the reduction of radiological hazards on nuclear licensed sites.
At the end of July 2006, CORWM published its recommendations favouring geological disposal for the UK’s arisings of ILW. The UK Government has given its support to the geological repository. However, considerable time will be needed for suitable repository site(s) to be identified, local communities to be engaged, planning and regulatory consent to be granted and the waste repository (or repositories) to be constructed.

In these circumstances, producers of radioactive waste cannot plan on the assumption that a route will become available for ILW disposal or for the final disposal of LLW that is unsuitable for the national LLWR, on any specified timescale. This is reflected in NII’s guidance to its inspectors, with an emphasis on the need to place such wastes in interim storage, with safety assurance being provided by conditioning to a passive safe state with a NDA Radioactive Waste Management Directorate Letter of Compliance (in a process overseen by the Environment Agency’s Nuclear Waste Assessment Team) and increased emphasis being placed on the operation of the “waste hierarchy” to ensure adequate standards of radioactive waste management.

There are also concerns over the long-term viability of the national LLWR as an authorised disposal site.

Another regulatory challenge is the NDA’s aspiration to reduce the timescale for decommissioning plant on sites where it has responsibility, from 80-100 years to possibly 25 years. NDA’s plans to restructure the decommissioning licensees (Magnox Electric and UKAEA) into smaller site licensee companies (SLCs) each run by an M&O contractor, presents a further regulatory challenge. The M&O contractors will be required to compete for relatively short-term contracts to run their SLCs and for successive contract renewals.

**Regulatory and research goals**

To ensure a sound technical basis for the safe and timely retrieval, passivation, immobilisation, containment and interim storage of radioactive wastes on both operating and decommissioning nuclear power and nuclear chemical plant sites, both now and for the future.

**Research strategy**

The processes and technology of waste and decommissioning has been the subject of considerable research and development by the Industry. Issues in this section of the program may be cleared by establishing a program of basic research, by the enhancement of existing work to target it for specific application, by collating information from existing facilities or by analysing existing data/information.

In 2002 the waste and decommissioning technical group of the IMC (UK reactor R&D managing body) carried out a review of R&D (assisted by Quintessa). One conclusion of the group was that the review had generated a structure for waste and decommissioning research that was generic in terms of the topic and the requirements of the various parts of the UK nuclear industry. It is considered by NII that the structure derived by the original IMC workshop is generic and can be applied equally as well to the R&D needs of power reactors and chemical plant. This R&D needs identification work was further developed in 2004/5 after a joint NDA/HSE workshop.

Following this Workshop, the scope of the original IMC technical group has expanded to encompass the interests of all the decommissioning licensees, and the waste and decommissioning interests of British Energy, AWE, MoD, NDA, (including its Radioactive Waste Management Directorate) and is known as the NWRF – Nuclear Waste Research
Forum. This Forum reports directly to the NDA Research Board and coordinates the generic NDA-funded waste and decommissioning R&D programmes that are undertaken by the NDA’s SLCs. This Group provides a focus for research collaboration between decommissioning licensees that have issues in common and with the Waste and Decommissioning R&D programmes of BE and the defence licensees, to ensure that the benefits of this research is shared across the UK nuclear industry.

The required research programme will address the short, medium and long-term aspects of the decommissioning cycle and cover the following areas:

- **Waste Characterisation** – physical, chemical and radiochemical compositions. (Quintessa Technical Issues 1.1, 1.2 & 1.3)

- **Waste Retrieval** – develop techniques for the removal of solid, liquid and sludge wastes from ponds, silos and debris vaults. Develop techniques to prevent or mitigate the consequences of the anticipated hazards of waste retrieval such as hydrogen release or Uranium Hydride and combustible metal fires. (Quintessa Technical Issue 2.11)

- **Decontamination of non-activated structural components of reactor and chemical plant** – develop and maintain up to date knowledge of- and develop as necessary, physical and chemical techniques to remove radioactive contamination so that such components can be disposed of as LLW rather than ILW or be sent for free release. (Quintessa Technical Issues 3.1, 3.2, 2.1, 2.3 & 2.6)

- **Waste treatment and passivation** – in particular develop processes for waste segregation, and volume reduction for used ion exchange resins, activated or contaminated metals, construction materials and graphite. (Quintessa Technical Issues 2.12, 2.9, 2.1, 2.3, 2.6 & 2.8)

- **Waste immobilisation** – grout formulations, novel encapsulents such as polymers and evaluation of new processes, such as vitrification of ILW using the AMEC Geomelt process, for orphan wastes. (Quintessa Technical Issues 2.3 & 2.12)

- **Effluent control** – Develop processes to limit the discharges of liquid and gaseous radioactive and chemical effluents that arise from the waste retrieval, decontamination and treatment operations. (Quintessa Technical Issues 2.1, 2.2, 2.4 & 2.5)

- **Waste packaging** – R&D to ensure that wastes remain passively safe during interim storage in an ILW store without need for reworking or overpacking. Develop techniques to monitor and mitigate the ageing processes that occur in prolonged storage such as corrosion, so that the packages retain sufficient structural integrity to enable them to be transported safely to a repository for final disposal. (Quintessa Technical Issues 1.4, 2.2, 2.10, 2.12 & 2.13)

- **Plant dismantling** – R&D to ensure that strategies and techniques for the safe dismantling of decommissioned plant are available, in particular for the removal of activated components from reactor cores. (Quintessa Technical Issues 1.3, 3.4)
• Remediation techniques for contaminated land – R&D to ensure that sites will be able to meet delicensing criteria. (Quintessa Technical Issues 4.1, 4.2, 4.3, 4.4, 4.5)

The following are technical areas where decommissioning licensees would also be expected to have active R&D programmes or at the very least, could demonstrate that they are maintaining an up to date awareness of developments in these areas and can demonstrate ‘intelligent customer’ capability.

• Radiological Protection - The assessment of risk from radiation is an integral part of assessing the safety of radioactive waste retrieval, processing and nuclear plant dismantling. There is an on-going need to maintain expertise in this field and an up to date understanding of developments in the UK and overseas, covering research in the areas of radiobiology, radiation protection and epidemiology, to support risk assessments and secure compliance with IRR99. (NRI Issue 12.6.1)

• Fault Modelling – In common with operating nuclear chemical plant, modelling the consequences of faults arising from hazards such as hydrogen explosions, combustible metal fires and criticalities is essential to the development of deterministic and probabilistic safety cases to support defuelling, waste retrieval, waste processing and plant dismantling operations. Increased decommissioning activities mean that new types of hazard may be identified that need to be addressed by R&D to ensure the production of adequate safety cases. (Quintessa Technical Issue 7 & Sellafield Nuclear Research Strategy Statement on Fault Modelling and Risk Analysis)

• Probabilistic Safety Analysis (PSA) - Although there is now a diminished need for further research in the basic methods of PSA, there is increased interest in improving existing PSAs so that they better support safety decisions at both operating and decommissioning nuclear installations. In particular, decommissioning licensees need to collaborate with operating reactor licensees to improve the methods used to evaluate common cause failure probabilities for PSAs (including compilation of relevant data to support this). (Quintessa Issue 7, NRI Issues 11.2.7, 11.2.15)

• Human Factors - This area addresses the vital contribution that human beings make to the safe operation of waste management and decommissioning operations. Decommissioning licensees therefore need to contribute fully to the Human Factors research programmes being undertaken by operating reactor and nuclear chemical plant licensees. (Quintessa Issue 7, NRI Issues 10.1, 10.2, 10.3, 10.4 & 10.5)

• Control and Instrumentation (C&I) – This area addresses the issues associated with the production, installation, modification or replacement of computer-based systems important to safety, maintenance of legacy and ageing C&I equipment, technological developments in the area of C&I systems (such as SMART sensors and commercial off the shelf based systems) and development of hardware based C&I systems important to safety. These issues are common to operating and decommissioning reactor and nuclear chemical plant licensees, especially if a waste retrieval or
treatment operation involves the construction or installation of new plant.
Collaboration between all UK licensees in this area is therefore encouraged.
(Quintessa Issue 7, NRI Issues 9.1, 9.2)

Future R&D activities need to be structured to ensure significant gaps in the knowledge base are anticipated and relevant work is actioned. The TBRD arrangements developed by the NDA are a powerful way of achieving this. The actual timescales needed for the above work, will vary from site to site, depending upon the complexity of the treatment needed to retrieve, passivate and immobilise the waste and the inventories of radioactive waste present on each site and of course for operating plant, how near they are to the end of their operational lives. These timescales are defined in the Life-Cycle Baselines each site produces for the NDA.

As the decommissioning programmes progress, priorities for R&D work may be expected to shift from the current waste retrieval, treatment, immobilisation, packaging and interim storage to the development and achievement of site delicensing criteria.

Essential Capability and Independence

No immediate problems are anticipated in maintaining essential capability or independence in the waste and decommissioning technical area. However, this needs to be reviewed regularly to ensure any such scarce resource can be protected as necessary. Such reviews must also include the technical areas that support waste management and decommissioning operations.

Another development to be considered is that a significant move on new build may draw R&D resources and capability away from the radioactive waste and decommissioning programme, such that progress on legacy matters will be threatened if adequate succession planning is not in place.

In the medium and long term it is generally accepted that the NDA and the UK nuclear industry need to take steps to ensure the availability of adequate knowledge and expertise in order to manage radioactive wastes and decommissioning safely. If a National Nuclear Laboratory is established, this laboratory could play a key role in developing and maintaining key skills to support the Decommissioning Programme.

International Activities

There have been significant commitments made to waste and decommissioning by, for example, the European Union, OECD/NEA and IAEA in addition to overseas operators and utilities. It is important that any research proposed is tailored to the specific circumstances and/or types of waste that apply in the UK. An example of this is the Euratom FP7 CARBOWASTE programme (irradiated graphite treatment and disposal) that is expected to commence during 2008-09 with contributions from a number of UK organisations.

All UK Nuclear Licensees should look for opportunities to develop collaborative programs with overseas organizations to optimise the benefits of research funding and reduce the possibility of duplication of effort.