

OPEN GOVERNMENT STATUS:

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

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**EVALUATION OF THE UKAEA 2006/07 PROGRAMME OF NUCLEAR  
SAFETY RELATED RESEARCH**

**PAPER BY UKAEA**

**INTRODUCTION**

- 1 UKAEA is the Site Licensee Company for Dounreay, Windscale, Harwell and Winfrith, as well as managing the programme for the Culham site.
- 2 At the meeting of the NuSAC Sub-Committee on Research in February 2007, UKAEA presented a summary of its nuclear safety related research programme for 2007/8 (1).
- 3 Each UKAEA site produces a Technical Baseline and Underpinning R&D (TBURD) document for the NDA in support of site Lifetime Plans. These are collated and summarised in a single UKAEA Technology Plan which also identifies the safety related research addressing HSE's issues of interest. The UKAEA Technology Plan 2007 included an evaluation of the benefits of the UKAEA research and technology development programme. The key items are summarised below and are separated into key project R&D, safety development work and key generic R&D.
- 4 Next year's safety related issues of interest to HSE will be separately identified in the individual site TBURDs.

**SUMMARY OF PROJECT RESEARCH AND TECHNOLOGY  
DEVELOPMENT SUCCESSES**

- 5 There have been a number of key project focussed research and technology development successes supporting hazard reduction in the site Lifetime Plans. The table below groups the successes under each UKAEA site although some items contain elements of collaboration between the various sites.

Table 1 Project Focussed Technology Successes

R&TD Successes	Example of Safety Benefit
<b>Dounreay</b>	
Development of WVN process	Reduced risk of pressure excursions. Reduction in inventory of hazardous material.

	Caustic effluent neutralised at source.
Use of ROV for particle detection on areas of the seabed	Eliminates risk faced by divers.
Shaft Isolation project	Isolation of radioactive waste from groundwater which will greatly reduce groundwater entering the shaft and becoming contaminated.
Development of PFR Pipe piercing tool	Development of equipment to assist in the draining of sodium from the complex reactor pipe work geometry and hence reduce the inventory of hazardous material.
PFR Effluent treatment plant	Abatement of liquid waste discharges.
Radiation seeking gamma camera to detect and retrieve radioactive material	Improvements to rapid determination of the location of hot spots and general characterisation of plant areas. Facilitates in the early removal of hotspots. Gamma cameras have the potential to reduce operator dose uptake on a variety of decontamination tasks by reducing the need for a hands-on approach.
DFR decommissioning - confined space innovation	Linking a camera in the confined space to a laptop has improved communications between workers and observation teams.
Cementation trials for immobilisation of liquid ILW in cement at Dounreay and Harwell	Reduced mobility of hazard. The final product will be passively safe.
Centrally Indicating Environmental Monitoring system at Dounreay and Harwell	Rapid dissemination of environmental information supporting overall goals for environmental performance.
<b>Harwell</b>	
Field trials of soil vapour extraction techniques for chlorinated solvent contamination in chalk geology	The successful development of soil vapour extraction is enabling the removal of significantly greater quantities of contamination in the source term area than can be achieved by the groundwater plant alone and is expected to reduce remediation timescales. This work is of wider interest than the nuclear industry and is applicable to contaminated land remediation more generally
Successful trialling of the Blast and Vac technique for surface decontamination	The total number of ISO containers consigned to Drigg from Harwell was reduced preserving the capacity of the LLWR for other wastes. The use of the technique resulted in a reduction in low level waste volume of 85% from the original estimate.
Development of polymer encapsulation for radium contaminated ILW	The use of polymer encapsulation results in a reduction of the emanation of radon gases from the wastes, which will reduce worker exposure to radon and discharges to atmosphere during processing of these wastes to make them passively safe for long term storage.
Large scale grout trials to investigate chronic hydrogen evolution during encapsulation of ILW containing aluminium. Computational fluid dynamics modelling work to assess the impacts of hydrogen evolution on the ventilation systems of the buildings concerned.	The outcome of the R&D activities is a significant reduction in the assessed programme risk relating to hydrogen evolution during the encapsulation of ILW containing aluminium. Hydrogen generation was identified as a potential challenge to the ventilation systems of the RHILW store and the Waste Encapsulation Plant (WEP). The issue of hydrogen evolution has not been found to be

	significant for WEP and no significant modifications are required to the RHILW store ventilation system.
<b>Windscale</b>	
Supporting technical work for the Pile 1 Operational Safety Case (OSC)	A number of technical packages of work were undertaken to support the safety arguments made in the OSC. The related papers were considered by the Windscale Projects Technical Committee. As a result of these studies the OSD was able to demonstrate that neither a criticality event nor a dust explosion event will occur, and that, if present, uranium hydride will not be a significant hazard. The revised OSC has justified reducing the radiological hazard category of the facility from 1 to 2.
Completion of survey and characterisation activities enabling removal of the Thimble Flask. Contaminated items within the flask were identified and removed.	Reduction in hazard potential.
Trials of Pile 1 Fuel and Isotope removal and segregation equipment	Enabling progress to next phase of hazard removal.
Assessment of Pile 1 West Air Inlet Duct (WAID)	The information gathered will be used to determine the Duct's current radiological state and to determine an optimum strategy for its demolition.
Removal of debris from WAGR Tundish	The debris was removed using remotely deployed tools and packaged for disposal.
Tube assembly removal from Discharge Face Temperature System Rig (DFTS) Rig	Supporting activity for removal of fuel and isotopes from Pile 1 The work was also possible as a result of the downgrading of the hazard category of Pile 1 following approval of the new Safety Case.
Pile 1 D void interior characterisation	The initial survey indicated that the area was not contaminated.
Pile 1 Fuel and isotope helical screw liner operation	Configures waste in box avoiding labour intensive remote pick and place and also avoids criticality incidents in waste packaging operations.
<b>Winfrith</b>	
Scale/Skeletal model of SGHWR and Dragon neutron source environment	Investigation and trialling of various cutting techniques before working on the actual reactor has allowed the resolution of safety issues during practice runs.
Remote decommissioning trials to prove the practicality of remotely operated vehicle (ROV) deployment of Brokk tools	ROVs will increase the safety aspect of the process by enabling personnel to be remote from the activated environment and to operate in less restrictive conditions.

## SAFETY DEVELOPMENT WORK

- 6 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 the field of Radiological Protection including understanding developments in the UK and overseas into research in radiobiology, radiation protection and epidemiology, to support risk assessments and secure compliance with IRR99. The specific approach for each site may vary but overall the

approach includes but is not limited to membership of national and international bodies, attendance at networking fora, dissemination and adoption of cross-industry best practice and continuous professional training.

- 7 Monitoring of development requirements in Hazard Identification and Fault modelling and Probabilistic Safety Analysis is provided and co-ordinated through Safety & Assurance Division and promulgated through the updating of the UKAEA Safety Assessments Handbook (SAH) and the safety case process. There is a three year rolling programme to review, maintain and update the SAH.
- 8 Human Factors assessment also forms part of the Safety Case process. UKAEA attends the Working Group for Human and Organisational Factors (WGHOFF) to exchange information and experience about safety relevant human and organisational issues, including benchmarking when appropriate; reviewing where further research is needed; collaboration with other groups as necessary.
- 9 Control and Instrumentation issues are monitored and disseminated through Engineering Services Group. The specific approach for each site may vary but overall the approach includes but is not limited to membership of national and international bodies, attendance at networking fora, dissemination and adoption of cross- industry best practice, continuous professional training.

## **KEY GENERIC DEVELOPMENT WORK**

- 10 The programme of generic development work undertaken during 2006/07, supporting progressive hazard reduction, has covered:
  - Encapsulation grout development and performance
  - Dose rate assessments in support of decommissioning the Windscale Piles to input to characterisation and assay advice
  - Waste optimisation and minimisation studies in support of decommissioning the Windscale Piles
  - Development of land remediation techniques and assessment of remediation technologies
  - Development of land quality data management systems and Geographical Information Systems (GIS) supporting progress to the next phase of hazard removal.

## **CONCLUSIONS**

- 11 UKAEA's safety related research and technology development forms part of its wider R&D programme. The whole programme has been evaluated during the production of the 2007/08 documents and has highlighted significant benefits.
- 12 In future years safety related research will be evaluated as part of the site R&D management and reported in the site TBURDs.

**ACTION REQUIRED**

13 The sub-committee is invited to note and comment on the paper.

**REFERENCES**

1. NuSAC/SCR/07/6 UKAEA: 2007/8 Programme of Nuclear Safety Related Research, February 2007