

Open Government Status:

Fully Open

NUSAC/SCR/06/21 Rev.1

**HEALTH AND SAFETY COMMISSION
NUCLEAR SAFETY ADVISORY COMMITTEE
SUB-COMMITTEE ON RESEARCH**

3 October 2006

**EVALUATION OF BRITISH NUCLEAR GROUP SELLAFIELD LIMITED
SAFETY RESEARCH ARRANGEMENTS IN 2005/06**

Paper by British Nuclear Group Sellafield Ltd.

INTRODUCTION

1. In accordance with the established Sellafield Safety Research Arrangements agreed with HSE, a Nuclear Research Schedule (NRS) was produced in March 2005.
2. This Evaluation Report identifies progress made in topics identified in the NRS for each technical area. In accordance with the Arrangements, appropriate contact has been maintained throughout the year between BNGSL and HSE technical personnel to communicate and monitor progress. The reviews below illustrate the success of the arrangements in 2005/06 in increasing the visibility and transparency of key Sellafield research to HSE and NuSAC SCR.

TECHNICAL AREA REVIEWS

3. The progress on key research topics/issues identified in the 2005/06 Sellafield Research Schedule is summarised below.

- **Civil Engineering**
 - **Ageing and Degradation Mechanisms**-A number of reports were completed addressing topics including B211 Roof Assessment, Nitric Acid effects on THORP Feed Clarification Cell: Structural steelwork corrosion tests (subjected to immersion & vapour) complete NS6471, external/internal survey of SETP tanks and B30 Satisfactory performance of aged Asbestos Cement cladding & fasteners. CS&A LFE in-house forums were held bi-monthly throughout 05/06 and in house electronic access was provided for Key Civil Engineering CS&A documents. A cathodic protection is being installed to extend the life of the Sea Line Pipe Bridge its effectiveness will be monitored & reported.
 - **Pond Containment with particular reference to leakage processes, leakage rates and leak detection mechanisms**-B30 Studies on water bars were completed and reports provide confidence for continued safe operation. Empirical methodology for estimating leakage proved to be inconclusive. B30 are to undertake study on implications of water bar / joint layout details and concrete makeup (i.e. cements, additives, water content etc. B30 is now developing strategies to identify and mitigate for any degradation leading to leakage (of any scale) and subsequent incorporation into emergency instructions for all ponds. B38 is also now undertaking 6 monthly Radsan surveys for future comparisons.
 - **Application of current design codes for design and assessment of nuclear structures**-Existing design Guides & Standards are being maintained to provide for current project requirements and in the main use British Standards as the basis for their criteria. Eurocodes: staff in house training continues with sessions covering EN1990 & EN 1991 with EN 1992 training arranged. Champions have been nominated for specific codes and names posted on internal department web site.
 - **Long life Structures**-A CS&A Guide: Design for Concrete Durability in New Structures was completed (ref RP/DES-CAP/CSA/00051-A). The CS&A Generic (template) specification includes details of high performance concrete for 100 year performance for new structures. Further work on the CS&A specification is needed to comply with EU rules.
 - **Maintenance and Repair techniques for use in the nuclear industry**-A Report "Maintenance and Repair Techniques for use in the Nuclear Industry " Proj No 0/103583 was issued to the NII Subsequent discussions have taken place.
 - **Non destructive testing**-Non destructive testing work was undertaken for example that described in the issue related to Ageing and Degradation addressing the B211 roof assessment. A number of techniques have been considered for example consideration of acoustic monitoring to aged pre-stressed roof beams.
- **External Hazards**
 - **Development of Seismic ALARP Methodology**-A high level guide was produced and published as a BNFL standard on the application of seismic ALARP to existing structures for continued operation, modification, POCO and decommissioning.
 - **Application of Seismic Probabilistic Safety Assessment (PSA)**-No significant progress on 04/05 in this area due to prioritisation of funds.
 - **Climate Change**-Watching brief was maintained, primarily through the United Kingdom Climate Impact Programme.
 - **Seismic Hazard techniques** - No significant progress on 04/05 in this area due to prioritisation of funds. Plans were made for research on a smaller scale to be carried out in the Seismic, Extreme Hazards and Geotechnical Centre of Expertise.
 - **Extreme Wind Loadings in a closely spaced plant area** - No significant progress on 04/05 in this area due to prioritisation of funds.
 - **"Beyond Design Basis Events" Assessment Techniques**-Specific research on non-linear cracking of concrete structures cancelled due to lack of Direct Portfolio funding. Similar techniques were promoted on a specific project to

evaluate the changes to the response of masonry panels as they cracked under seismic loading and their ability to provide continued structural stability. This is currently being implemented on the project and the generic lessons will be captured and reported. Revised design criteria were published and are now in use.

- **Review Modern Standards**-Transition towards the Eurocodes in general was promoted through CS&A Eurocode nominees, of which the Technical Representative in this area covers EC0, EC1 (loading) and EC8 (seismic). Discussions held with NII and BRE on benefits and pitfalls of Eurocode implementation. New criteria for seismic design of BNGSL structures were published.
- **Human Factors**
 - **Root Causes**-It was decided to address this issue by including it within the scope of the main research project (discussed below). That project was completed on schedule at the end of March 2006 by independent Human Factors consultants. It concluded that the amended WANO causal coding system is appropriate for the Sellafield OEF process.
 - **Clarify the characteristics of an effective and best practice OEF system for nuclear chemical plant and to determine the extent to which current MSS arrangements meet these**- The research specification was completed, potential contractors were identified and research contract was placed on November 2005. The research was completed and the final report issued on 30 March 2006.
 - **Monitoring of other licensees programmes** - Work was reviewed in May 2005. A number of new research areas were identified. These and the ongoing research areas are being monitored as the research areas are addressed, through liaison with Human Factors specialists in British Energy and British Nuclear Group Reactor Sites.
- **Internal Events/Fire**
 - **Inclusion of data on number of people evacuated and the duration**- Expected to be complete before end of 2006.
 - **Inclusion of data on damage caused by fire**- Expected to be complete before end of 2006.
 - **Roll out of Fire Call database**- Data bases have been identified that can all be interrogated for fire related events and analysis is to be carried out by BNGSL /S&RM Fire Engineering Group. The databases identified are PROSAFE, Safety Culture Database CBOS (behavioural observations) and decommissioning learning library.
 - **Promulgation of best practice in fire assessment and management across sites**- Proactive membership continues to be a priority of the BNGSL /S&RM Fire Engineering Group and many mutually beneficial topics are debated.
 - **Best practices in industries other than nuclear facilities**- BNGSL/ S&RM Fire Engineering Group have joined the joint Oil and Industry Fire Forum
 - **Understanding design challenges to ventilation systems used on nuclear chemical plant caused by fire**- Preliminary discussions have taken place between BNGSL /S&RM Fire Engineering Group and ventilation design authority with the view to a joint project to determine suitable means of taking account of fire growth in treatment of contamination control ventilation systems.
 - It has been mutually agreed between BNGSL and NII that the area of internal hazards need no longer sit within the current research arrangements between BNGSL and NII. Issues in these areas will be addressed in future through the Process Technology section.

- Plant Materials
 - **Confirmation of inspection procedures for Plutonium nitrate evaporation plant-** Inspection procedures confirmed with NII, Magnox plant inspected, results were transmitted to NII.
 - **HAL clarification of effects of oxidising species-** Demonstrated that some nitrosyl complexes are corrosion accelerators and some are not. Speciation studies underway to identify those existing in plant liquors
 - **Assessment of impact of temperature on pitting propagation in HA systems-** Work completed. Relatively little effect of temperature could be discerned within background variation
 - **Assessment of pit propagation models-** Discussions are ongoing with the alliance. Modeling studies for SCC have been proposed by alliance but no pitting corrosion studies have been agreed.
 - **Development of inspection options for HAE -** Push systems have been developed and successfully rig tested. However, when deployed in plant it was found that the pipe work was more restrictive to movement than anticipated from the drawings and full deployment was not pursued. The programme is being reassessed. Initial appraisal of under tank inspection options did not reveal any applicable new technology. The success of an ultrasonic inspection would be dependent of sludge levels in the water system.
 - **Procedures for localised corrosion inspection-** Work completed. A document defining the recommended procedure has been issued. The principal methods have been assessed. Further refinement of the methods is being considered.
 - **Assessment of AGR storage options-** No research work is ongoing pending the results of BNG internal policy discussions
 - **Co-ordination of ILW inspection with MGBG-** Discussions have been held with MGBG. A targeted autumn meeting is planned to involve the various interested NDA sites.
 - **Assessment of environmental conditions to induce SCC on ILW drums-** Delayed due to six month absence of student. Study now resumed. Report due in autumn.
 - **Development of NDE methods for crack /corrosion detection-** Acoustic emission study underway. Assessment of corrosion processes planned for next year. Programme started and a report due at end of the year. Progress made on focussing waves along welds. Nuclear test pieces supplied. Initial programme coming to completion. Detection of pits demonstrated in stainless steel plant specimens. Proposal for development of plant instrument being considered. Studies commenced in April at Warwick. Eddy current report issued considering the use of eddy currents in various plant areas including WVP. Report being considered internally. Eddy currents being considered for application in THORP plant.
- Process Technology
 - **Flammable Gases-**The specialist working group continues to work within BNGSL. The HWP held 7 meetings 05/06; Several sections of Hydrogen Technical Guide were updated to reflect developments. Two papers on hydrogen research were presented to IChemE Major Hazards Symposium. Links were established with UK Hydrogen Association, to ensure BNGSL is aware of best practice. Hydrogen Forum (pan-nuclear forum) held March 2005. Follow up meeting of Hydrogen Forum was delayed to November 2006 because of industry re-structuring
 - **Unstable By-Products-** Work undertaken in 2005 in support of High Active Evaporation was reported in March. Further work programme planned 06/07.
 - **Two Phase Mixtures of Solids in Saturated Solutions -**Thermal modelling work completed, future work being considered. Experimental investigations of evaporation and crystallisation phenomena are underway in accordance with the programme of work in support of the High Level Waste Plants. Evaporation

reviews and experiments underway, Magnox work completed, oxide/blended work continuing. Gamma irradiation studies on hold pending clarification of sample and facilities availability.

- **Volatile Radionuclides**- Experimental work to support a Safety Case for known stocks of material committed for reprocessing has been completed.
- Probabilistic Safety Assessment
 - **Consequence Analysis - Appropriateness of current resuspension and deposition factors for decommissioning activities** - Report produced and issued. No further work is planned.
 - **Consequence Analysis - Validation of in-house codes** - Report issued - No further work planned
 - **Consequence Analysis - To carry out a phased review of the adequacy of the current release fraction and decontamination factor data, to seek new sources of relevant data, and to produce new experimental data in specific areas.** - A Review of a number of RFDB sheets is being carried out for the NII by HSL labs at Buxton. When this review is complete any issues raised will allow a strategy of to be produced for future research if required.
 - **Consequence Analysis - Seek out new data sources for high-risk areas and decommissioning** - Investigations are ongoing to confirm releases caused by cutting operations. Any other issues that are identified as problems will also be reviewed as required.
 - **Human Action Representation** – A detailed Technical Guide on the subject of Human Dependency and Human Performance Limiting Values is expected to be issued this year.
- Nuclear Physics
 - **ILW Methodology**-Methodology development and consensus building with industry and regulators was continued through the Working Party on Criticality (WPC) sub-group (attended by NII). Topics under discussion have included the setting up of a banding scheme in order to aggregate similar waste streams into categories; decision processes for evaluating the optimum (with respect to safety and risk) packaging/assay arrangements for waste streams; methods of making off-site transport criticality cases for fissile bearing wastes. A draft S&RM Technical Guide has been produced to provide guidance on the methodology and how to apply it. The specific issue has been closed. This area of development will continue in FY2006/7 via continued participation in the WPC sub-group. This activity will continue to be subject to ongoing review via SSRA until the methodology is suitably developed.
 - **Low Risk Methodology**-Overview being maintained of ongoing work in area of PCM methodology. Methodology in low risk decommissioning operations continues to be developed. The issue was closed.
 - **Criticality ALARP Methodology**-Formal criticality ALARP training course was addressed and a course is being developed (scheduled to be run in February 2007). Issue was closed.
 - **Non-intrusive assay of moderator content**- Review performed of existing and potential new measurement techniques. Concluded that no safety driver or business case identified for undertaking development/ procurement of additional moderator investigation techniques. A watching brief will be kept of technology available in the area. Work was performed (as part of SIRP project) to better understand the physical/ chemical mechanisms for moisture uptake in PuO₂. This information has been used in safety cases to provide a better understanding of the margins of safety present. Information reviewed at a meeting with NII in January 2006. It was agreed that further investigation in the area is not necessary and the issue should be closed.
 - **NDA measurements validation**-Several meetings were held involving representatives from relevant key areas (e.g. Waste Treatment Plants, CE&I, BIL Solutions, Criticality Technical Manager for Waste Management and

Decommissioning) to discuss the issue. A meeting, led by Waste Treatment Plants (WTP), was held with NII in January 2006 to discuss the issue (reported in more detail in the 2005/06 research schedule). Actions were placed on WTP to investigate the feasibility of chemical dissolution and calorimetry. This issue was closed in the 2006/7 research strategy.

- Radiological Protection
 - **Validation of in-house codes and data used for radiological assessments** - Passed to the Risk Analysis programme
 - **Resuspension and deposition factors in dispersion modelling calculations**- Passed to the Risk Analysis programme
 - **Restriction of the spread of activity** - Issue was closed following the issue of formal guidance (MSS/RPDS/05, Sub-change room requirements for new plant, (formerly NF0082/5) and SSP 1.06.03 Radiological Clearance)
 - **Good practice ALARP**- Issue was closed following issue of MSS/RPDS/12, Design Considerations for Prevention of Radiological (Pu) Contaminated Wounds. Workshop on the subject was held by the WPC with one planned by the Shielding Forum for 2006
 - **Performance indicators for radiological protection**- Removed from SSRA as decided it was better dealt with through other channels.
 - **Subsidiary guidance on the principles for the protection of employees following a radiation accident**- Draft guidance received from HPA and been discussed internally

- Waste and Decommissioning
 - **Ion exchange and filtration**-Progress in 05/06 has been in terms of continuing informal technical exchange between experts on a one-to-one basis. Technical exchanges have been by video conference, site visits and at least 1 formal meeting. The technical learning has provided valuable input into improving filtration and ion exchange in SIXEP and water treatment at the Magnox reactor ponds
 - **Treatment of waste oils**- The forward plan for waste oils was developed within the Orphan Wastes project. The value in developing a cross-industry approach was fully recognised within the project although much of the focus centred on improved understanding of the nature of the wastes and the volumes involved.
 - **Collaboration with MAGNOX Reactor Sites**- The principal mechanisms for collaboration with Magnox Reactor Sites has been *via* attendance and participation in the Reactor Waste & Decommissioning Technical Group (RWDTG) and Reactor Waste & Decommissioning Industry Group (RWDIG). Sellafield has contributed to the RWDTG's development programme for 2006/7. Summaries of work on the Sellafield Site Remediation Innovation programme have also been shared with RWDIG attendees, and have included detailed discussions on areas such as long wavelength ultrasound for pipe inspection. Additional mechanisms for building on areas such as these included setting up of a 'Technology Collaboration' Group in 2005/6.
 - **Collaboration with UKAEA**- UKAEA's attendance at the Reactor Waste Decommissioning Industry Group has provided a useful mechanism for BNGSL/UKAEA personnel to explore common issues. Additionally, BNGSL have worked together with UKAEA to develop approaches/ propose common solutions/ understand emerging issues at Regulatory workshops and University Research Alliance (URA) meetings. For these reasons it has been decided not to pursue setting up a separate bilateral exchange with UKAEA at this stage.
 - **Clarify how MSS will interact with the NDA Direct Portfolio Programme** - BNGSL has had strong interactions with the NDA on the direct portfolio programme. BNGSL has participated in a series of consultation exercises, for example: 'ILW Treatment and Storage' and 'Graphite Waste' and was an active part in additional gate meetings. BNGSL was responsive to requests to provide

advice , along with other SLC's , on the content and relevance of such projects and is committed to continued interaction.

- **Control and Instrumentation**
 - The majority of the CE&I Nuclear Research Issues are addressed in collaboration with British Energy and British Nuclear Group Reactor Sites through the C&I Nuclear Industry Forum (CINIF). This collaborative approach not only brings benefits in terms of shared costs, but it also facilitates interaction between licencees whilst addressing the NRI issues, thereby bringing a consistency to the solutions to similar problems.
 - A significant number of issues were addressed through the production and delivery of reports and guidelines. These covered issues in **Software diversity , Statistical systems testing, Safety implications from use of PCs in low safety integrity level systems, Development of an Approach to the Assurance of SMART Sensor Software, Goal Based Assessment of COTS Products for safety related Systems, Evaluation International subscription and Further Investigations into Legacy Code Analysis**
 - **Complex safety related measurement and data processing systems-** Continuous review maintained through out the year
 - **Cost Effective Modernisation of Systems Import to Safety (CEMSIS)-** British Energy have maintained contact with the Framework 6 process and are involved in the 'MAGIC' project – Management of Ageing of I&C Components. Funding is not being provided by CINIF or BNGSL for this project as it is wholly funded by EU. CINIF consortium has however been declared as an interested party and will receive deliverables. NRI issue was closed out.
 - **Guidelines for Assessment of SMART Instruments Suppliers (EMPHASIS)-** Tool was delivered to allow assessment.
 - **Safety Implications of Using PLCs in Low SIL Applications-** Report delivered and issue closed out
 - **Statistical systems testing guidance note-** Guideline were delivered
 - **Vendor assessment of SMART Instruments-** Assessments for Yokogawa EJX and ABB 2600T pressure transmitters delivered.
 - **Dissemination of information-** Relevant Centres of Expertise, Safety Systems Forum and Nuclear Industry Smart Instruments Working Group briefed on relevant results.

CONCLUSION

4. The British Nuclear Group Sellafield Ltd. Safety Research Arrangements have been successfully delivered in 2005/06, and associated work programmes identified in the 2005/06 Nuclear Research Schedule have been substantially progressed with a number of issues closed out. The arrangements support the demonstration of balance and adequacy in the Sellafield nuclear safety research programme, and the positive contribution it makes to nuclear safety.

5. For 2006/07 onwards, it is anticipated the format of the Nuclear Research Schedule will be modified to complement information gathered for the Technology Plan that will be delivered to NDA. This move will provide a view of the whole technology needs for the site including safety. Those parts of the BNGSL research and development programme that address the NSD strategies will be highlighted in this document.

ACTION REQUIRED

6. The subcommittee is invited to note and comment on the paper.