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NUCLEAR SAFETY ADVISORY COMMITTEE

Review Group 6

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UK INTERNATIONAL STRATEGY FOR NUCLEAR SAFETY RESEARCH

Paper by ND including contributions from Nuclear Licensees and NDA

Aims

The aims of this strategy paper is to inform RG6 about the role international safety research plays in supporting regulatory and nuclear industry activities in the UK.

Objectives

The objectives that underpin international research arise from both regulatory and operational requirements. However, they are based on the same premise that the UK needs both indigenous research programmes and access to research and technical information available abroad. The internationalisation of reactor design and commonality of many safety issues provide the driver for coordinating research activities between countries and for sharing costs and results.

ND has a policy commitment from the DTI Guidelines that underpins the HSE Coordinated Nuclear Safety Research Programme to collaborate internationally so that ND and the nuclear licensees are able to benefit from research undertaken overseas.

ND needs access to safety information not always available in the UK both to inform in regulatory decision making and to ensure nuclear inspectors are well-informed about developments overseas. Inspectors also need to keep up-to-date with the state of the art of their own specialisms; involvement in research is one way to achieve this. The interactions with other regulators, representatives of Technical Support Organisations from other countries and researchers allows ND to peer review its own

technical activities and allows it to influence thinking on international safety problems.

A wider objective that although secondary is nonetheless important is that ND's international interactions may help benefit the wider UK nuclear community. This could be contractors supporting other parts of the industry, for example the Defence Programme, and researchers at universities being able to collaborate with equivalents in other countries and being given access to foreign codes, experimental data and nuclear data that can then be applied back in the UK. This type of collaboration can help develop and support key expertise in the UK and ensure safety assessments are undertaken with the most up-to-date knowledge and know-how.

The nuclear licensees need access to key expertise and data in a similar way to ND. Access to international collaborative programmes provides them with research data not available in the UK and helps to demonstrate that best practice is being followed and allows the industry to benchmark the approaches it is taking.

Collaboration Fora

Because of past levels of funding for research worldwide and the lack of indigenous expertise and facilities, most foreign regulators collaborate at some level on safety research. The uniqueness of the UK gas-cooled reactors (Magnox and AGRs) means that scope for collaboration on this technology is very limited because the few countries that may have operated these designs in the past no longer do so. However, the UK operates an internationally designed PWR (Sizewell B) and as a result draws on the considerable amount of operating experience worldwide and the significant research programmes that continue to be undertaken related to Light Water Reactors.

The OECD NEA provides the greatest focus of any international organisation on coordinated research through its Joint Projects on Nuclear Safety, Radioactive Waste Management and Radiological Protection. Although not exclusively, most of the research projects are hosted around an experimental facility in one country where the main share of the funding is provided in that country and where other countries contribute financially and with work-in-kind.

Multi-lateral collaborations between regulators and Technical Support Organisations (TSOs) provide a good complement to NEA projects. ND has Technical Exchange Agreements with regulators in a number of countries including USA and France. Research collaborations with the USNRC on code development provide access to up-to-date codes on thermal hydraulics and heat transfer and severe accident management which are employed to the benefit of UK civil and defence reactors. Collaborations with the French Regulator (ASN) will help provide ND's access to research undertaken at IRSN on the EPR.

The third and comparably important area of collaboration is through the EC's Fission Safety Framework Programme. ND provides an important UK lead in the Programme Management Committee (CCE) predominantly on Reactor Safety issues but also increasingly in the area of Waste and Decommissioning. The programme provides opportunities to researchers working in key nuclear contractors and universities to collaborate on important safety issues that cross national boundaries and has been a

key source of funding to help maintain and develop key UK safety expertise in the past.

The IAEA coordinates experts from many countries to work on developing safety standards but traditionally has not funded or coordinated research projects to the same scale or scope as the NEA.

There are a number of fora that the industry use to get access to international research, with the main one on reactor technology being EPRI. However, the industry actively participates in a number of the NEA projects, for example the Halden Reactor and the Cabri Water Loop Programmes and has actively supported participation of UK contractors and universities in EC projects.

Eurosafe provides an important forum for European TSOs to collaborate and coordinate activities. The three objectives of Eurosafe are to identify common safety research issues, to develop a common base for knowledge transfer and to develop a common Safety Assessment Guide. Eurosafe also has a regular publication and an annual conference to publish research outcomes. The role of Eurosafe is recognised by the EC and therefore it has representation in high level groups that help steer European research and helps to provide a counter to the ambitions and vested interests of large industry groups such as the CEA.

ND International Research Strategy

Over recent years it has become important that ND focuses on obtaining best value from its international activities. ND has an International Strategy for all its activities and this sets priorities that relate to both business and policy needs. In some areas the level of resources put into research matters has been reduced to match with needs of the business. In some technical areas this reduction in resource and activity is justified by the scaling down of research activities because of recognised maturity of the technology and significant reduction in research issues needed to be addressed. However, in others the number of safety issues has been increasing with the aging of the technology. The CSNI/CNRA working groups and bilaterals with other regulators have been an effective way of keeping up-to-date with developments overseas in a wide range of technical areas.

Generic Design Assessment (GDA) work has required quite a high level of international interaction with other regulators in order to allow a smooth transfer of knowledge and know-how on new designs of reactor. In particular access to USNRC codes through CAMP and CSARP, impact studies with VTT and general collaboration with IRSN and VTT, the TSOs in France and Finland respectively, are considered important to the assessment of new reactors. As a result new technical exchange agreements have been put in place with IRSN and VTT and currently ND is about to renew participation in CSARP and CAMP.

Licenseses International Strategies

British Energy

British Energy engages in international activities for a number of reasons including the following with examples given in each case;

1. Access to key expertise, facilities or data
 - Use of the materials test reactor at Petten for development of understanding of the behaviour of irradiated graphite
 - Involvement in the Halden reactor programme
 - Collaboration with NIMS in Japan to obtain long term creep data on austenitic stainless steels
2. Access to collaborative research programmes
 - Involvement in EPRI funded research programmes
 - Involvement in an EPRI organised activity, with organisations from the US, Europe and Japan, to establish long-term creep-fatigue methods and data
3. Engagement in joint research programmes, such as those partly funded by the EU, to share the costs of research and increase the volume of research output
 - Involvement in the NULIFE European network on nuclear plant life extension
 - Joint funding of a project on Formalising Goal-based Safety Justifications for C&I equipment with the Swedish Nuclear Inspectorate
4. Application of methods in benchmarking exercises to ensure UK methods adopt worldwide best practice
 - Long-term activity in the NESC (Network for Steel Components) network which involves participants applying modern fracture mechanics procedures to large scale tests
 - Creep fatigue crack growth testing as an input to a VAMAS (Versailles Agreement on Advanced Materials and Structures) programme that has led to a draft ISO standard for such tests.

Magnox Electric

While keen to collaborate with international organisations and programmes, as a small licensee, Magnox North does not have a formal International Strategy. Our general position, on pragmatic grounds, is to gain access to international programmes through the collaboration with the other Site Licence Companies. Typically we tap into international programmes, and identify required international expertise through overarching technical groups such as the Nuclear Waste Research Forum (NWRP), which we co-manage with Magnox South. Direct engagement with international programmes and bodies occurs on a project-by-project basis for several reasons including:

- (a) Provision of specialist technical information: such as involvement in the Halden Project which brings valuable spin-off information particularly in

Human Factors of remote access and modelling/simulation of work areas and Radiation monitoring.

- (b) Comparison with alternative approaches to demonstrate that best practice is followed, e.g. consideration of the alternative model of graphite creep developed at the Kurchatov Institute, Russia. We are keeping a watching brief on any research around Human Performance eg the Energy Facility Contractors Group (EFCOG) good practice web portal.
- (c) Staff development and maintaining SQEP. Presentation of work and attendance at several international conferences is both motivational to staff and provides opportunities to understand future skill requirements as new techniques are profiled.

Sellafield Ltd

Reasons for involvement in international programmes include accessing a specific capability that the organisation needs such as:

1. Skills or facilities
2. Accessing joint research programmes
3. Ability to benchmark, identify good practice or establish good practice
4. Ability to influence as a result of involvement
5. Improvement of staff technical skills

Following the break up of BNFL, involvement in international work programmes moved with the most appropriate organisation that was established. Sellafield Ltd would engage either by itself or with others in international activities against the reasons previously mentioned, when work requirements for site demand it. Examples include:

- Access a specific capability e.g. NEA Databank
- Access research programmes e.g. MOX Fuel irradiation programme
- Ability to benchmark and identify good practice e.g. involvement in external organisations such as IAEA, OECD etc
- Ability to influence as a result of involvement e.g. ISO criticality work
- Improvement of staff technical skills e.g. Involvement in conferences and workshops such as MCNEG, University of New Mexico/SL Criticality Workshops etc

NDA International Research Strategy

The NDA undertakes collaborative research work with a number of overseas organisations either bilaterally or multilaterally or under the auspices of international organisations such as the IAEA, European Union and OECD-NEA. Such research work may include direct involvement in specific international research projects or may be more ad hoc covering benchmarking particular topics for example.

Bilateral Agreements

The NDA has a number of bilateral agreements which allow for information and staff exchanges relating to a wide variety of subject areas relating to decommissioning and clean up and waste management. The following two have been extensively utilised for benchmarking areas such as decommissioning costing, lifetime plan development, project management:

- United States Department of Energy;
- EDF (Electricité de France) through its decommissioning arm CEDEN.

There also exists a number which are more focused on radioactive waste management:

- Nagra, the national WMO of Switzerland;
- ONDRAF/NIRAS the national WMO of Belgium;
- NUMO, the national WMO of Japan;
- RWMC, the Radioactive Waste Management Funding and Research Centre of Japan;
- SKB the national WMO of Sweden (2002).

An example of a research area with these organisations was the development of the UK's reference concept for the disposal of high-level waste and spent fuel utilising the SKB concept with input and review from Nagra and NUMO.

In addition NDA is finalising agreements with the Japan Atomic Energy Authority (JAEA) of Japan and ANDRA, the national WMO of France.

The NDA has become a member of three international organisations:

- The International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) which is a high level forum for WMO Chief Executives for exchange of views;
- The Club of Agencies, which is a grouping of EU WMOs plus Switzerland which discusses the progress of national programmes and Commission initiatives. It further acts as a discussion forum on radioactive waste management R&D.
- The Radioactive Waste Management Committee of the OECD-NEA exists to help member countries find long-term solutions for radioactive waste management and provides peer reviews of national programmes.

International Programmes

Typically, these projects will involve a number of Waste Management Operators, universities, national and commercial research organisation, and stakeholders.

The NDA is involved in the following Co-ordinated Research Programmes supported by the IAEA:

- On Chemical Durability and Performance of Spent Fuel and High Level Wastes under Simulated Repository Conditions.
- Factors affecting public and political acceptance for the implementation of geological disposal, with the aim of improving the understanding of what factors (conditions) affect (increase or decrease) public and political acceptance for implementing the disposal of long-lived radioactive waste in a deep underground repository.

The NDA is involved with the following research projects with OECD/NEA:

- Forum on Stakeholder Confidence which works to improve the understanding of the principles of stakeholder interaction and public participation in the field of radioactive waste management and to distil the lessons learned.
- Integration Group for the Safety Case which defines the scientific and technical processes, components, methodology and means of ensuring consistency that are required to build a long-term safety case.
- Approaches and Methods for Integrating Geological Information in the Safety Case (AMIGO).
- The Geosphere Stability Project.
- Engineered Barrier Systems (EBS) which is a multidisciplinary project to present an account of how EBS design is developed, justified and implemented using state-of-the-art knowledge.
- Working Party on Decommissioning and Dismantling which monitors and reviews the policy, strategic and regulatory aspects of the decommissioning and dismantling of obsolete nuclear installations in view of the ultimate release of sites for other uses.
- The Sorption Project producing guidelines on the use of chemical thermodynamic modelling approaches to support the selection of sorption parameters for safety assessments of radioactive waste disposal.
- Thermochemical Database (TDB) - makes available database of selected chemical elements.
- The Expert Group on Argillaceous Media (the “Clay Club”).
- Expert Group on Radionuclide Migration in Geologic Media (GEOTRAP).

The NDA is (or has been) involved with the following research projects within the European Union’s Framework Research Programmes which often contributes to funding the projects involved on a partnership basis:

- Near-field processes: NF-PRO. The principal objective of which is to establish the scientific and technical basis for evaluating the safety function of the near field of a geological repository for high level waste and spent fuel.

- Engineering Studies and Demonstrations of Repository Design (ESDRED). This project is investigating the technical feasibility, at an industrial scale, of activities carried out to construct and close a deep geological repository, and at the same time comply with requirements on long-term and operational safety, retrievability and monitoring.
- FUNMIG. This geosphere-related project is concerned with the FUNdamental MIGration of radionuclides. The NDA is involved in a task relating to the impact of multiple complexants on sorption which involves the Universities of Manchester and Loughborough.
- PAMINA. Performance Assessment Methodologies IN Application to guide the development of a safety case - the aim of which is to improve and harmonise performance assessment methodologies and tools for various disposal concepts of long-lived radioactive waste and spent nuclear fuel in different deep geological environments, in order to provide a sound methodological and scientific basis for demonstrating the safety of geological disposal.
- REDIMPACT: The aim of this project is to assess the impact of Partitioning and Transmutation on the waste management policy of member countries in the EU.
- CATT. Co-operation and Technology Transfer. The overall objective of the CATT study is to investigate the feasibility of Member States with small nuclear programmes implementing long-term radioactive waste management solutions within their national borders, through collaboration on technology transfer with those Member States with advanced disposal concepts.
- CARD. To assess the feasibility of a Technology Platform that would provide a European framework for networking and co-operation in the field of RD&D for geological disposal of radioactive waste in the EU. Project started.
- CARBOWASTE. Treatment and Disposal of Irradiated Graphite and Other Carbonaceous Waste.

The following are projects undertaken on a multilateral basis and are completely funded by the organisations involved:

- COWAM 2: The work is looking at implementing local democracy and participatory assessment methods; influence of local actors on the national decision-making process; quality of decision-making processes; and long-term governance.
- COWAM in practice. To support practical engagement initiatives in the UK and to provide review of the approaches effectiveness as part of the learning component - building on all that COWAM 1 and 2 achieved.
- Large Scale Gas Injection Test (“Lasgit project”) in the Äspö Hard Rock Laboratory.

- Specifying the Participation in the Grimsel Test Site Phase VI Project TEM – Test and Evaluation of Standard Monitoring Techniques.
- TRU (transuranic waste) workshops – meetings between countries involved in developing and practicing the disposal of TRU waste (roughly equivalent to long-lived ILW).
- DECOVALEX. Development of Coupled Models and their Validation against Experiments in nuclear waste isolation, an international cooperative research project to develop and test models of coupled thermo-hydro-mechanical-chemical processes in fractured rocks and clays.

Nexia Solutions international interactions strategy

Nexia Solutions (to become the Nuclear National Laboratory) strategic objectives for participation in international research programmes and governing bodies/committees are to:

1. secure funding to augment UK investment and provide leverage for its R&D programmes;
2. provide opportunities for its scientists/engineers to further develop their skills/expertise;
3. influence the direction/scope of research programmes;
4. enhance its reputation and that of the UK in general;
5. further develop networks with leading nuclear organisations;
6. provide technical guidance of the UK nuclear scene;
7. acquire information/data on the developments in other nuclear countries;

To achieve the above objectives Nexia Solutions' staff participates on a variety of committees/working parties including:

1. IAEA Fast Reactor technical Group;
2. IAEA LWR Working Group;
3. IAEA BIOPROTA- biosphere processes and data;
4. NEA Working group on criticality safety;
5. NEA Working Party on the Science of Reactor Systems
6. NEA Working Party on the Science of the Fuel Cycle
7. ASTM Expert sub-group on graphite;
8. NEA WPEC chemical partitioning working group.

Nexia Solutions in the past few years has established strong interaction with the EURATOM office that has produced:

1. inputs to the EURATOM FP 7 programme development. A good example is the inclusion of irradiated graphite in the first FP 7 call. This has led to a major project CARBOWASTE (total value > €12 million) being supported by the EU;

2. the development of the first EURATOM Technology Platform, ‘Sustainable Nuclear Energy’. Nexia Solutions is a member of the SNE-TP Governing Board;
3. Providing support to the HSE on the Eurosafe group
4. participation on the Consultative Committee EURATOM-Fission as a technical adviser.

It is currently campaigning for nuclear waste management to be a more visible component of FP7 and future programmes via SNE-TP.

More globally Nexia Solutions has agreements with a number of international nuclear research institutes to undertake collaborative work including:

1. USA for example Idaho National Laboratory covering the scope of the nuclear fuel cycle
2. France
3. Australia (ANSTO) on advanced wastefoms
4. South Africa (NECSA)
5. Japan (JAEA and CRIEPI)

Conclusions

1. UK participation in international nuclear safety research is a requirement placed on HSE under the original DTI Guidelines. These guidelines require HSE and nuclear licensees to seek opportunities to benefit from international research collaboration.
2. Benefits of participation to HSE, Licensees and NDA include access to facilities and skills not available in the UK such as Material Test Reactors (MTRs), the ability to undertake research in a cost-effective way, ability to benchmark and identify international good practice in regulation and plant operations, to influence the programmes of major nuclear safety research programmes that are of interest to the UK regulator, licensees or NDA and to provide opportunities for the development of staff technical skills in all UK organisations.
3. Euratom Framework Programmes provide a medium for international research collaboration for all UK organisations. In addition, HSE participates and takes the UK lead in a number of OECD/NEA research programmes. HSE also benefits from a number of bilateral exchange arrangements with overseas nuclear regulators and their TSOs, in particular with the USA, France and Finland. The UK nuclear industry undertakes international collaborative research with industry organisations and networks such as EPRI. NDA collaborates with a number of overseas Waste Management Operators.

Action

NuSAC Review Group 6 is invited to note and comment on the paper.

