13.6 International Activities

Examples of relevant international activities within the area of deterministic safety analysis include:

- Light water reactor heat transfer and thermal hydraulics, where activities led by the OECD Committee on the Safety of Nuclear Installations (CSNI) and US Nuclear Regulatory Commission (NRC) help meet UK research needs. For instance, the UK is participating in the OECD/NEA Rig of Safety Assessment (ROSA) projects, and the USNRC Code Assessment and Management Programme (CAMP).
- Light water reactor SAM, where OECD CSNI and USNRC-led activities help meet UK research needs. The OECD CSNI Working Group on Analysis and Management of Accidents (WGAMA) and the Severe Accident Research NETwork (SARNET) programmes are of particular interest.

14 RADIOACTIVE MATERIALS TRANSPORT

14.1 Introduction

Formerly part of the Department for Transport, the Radioactive Materials Transport (RMT) Programme of ONR acts on behalf of the Competent Authority for the transport of radioactive material by road and rail in Great Britain, whereby it regulates the safety (and in some cases security) of radioactive material in the public domain. It also performs certain functions on behalf of, and provides advice to, the UK Competent Authority for the transport of radioactive material by air and sea (and by road in Northern Ireland). As well as enforcing compliance, ONR RMT inspects a wide variety of dutyholders and assesses submissions for Competent Authority approval of certain radioactive materials, transport package designs and shipments.

Regulations governing the transport of radioactive material are based on standards developed by the International Atomic Energy Agency (IAEA).

14.2 Regulatory Objectives

The regulatory objective is to protect people and the environment from the effects of radiation during the transport of radioactive material. Protection is achieved by:

- Containment of radioactive contents;
- Control of external radiation levels;
- Prevention of criticality; and
- Prevention of damage caused by heat.

The principal assurance of safety in the transport of nuclear materials is the design of the packaging, which must allow for foreseeable accidents. The consignor bears primary responsibility for this. Many different nuclear materials are transported and the degree of potential hazard from these materials varies considerably. Different packaging standards have been developed according to the potential hazard posed by the material.

When radioactive materials, including nuclear materials, are transported, it is important to ensure that radiation exposure of both those involved in the transport of such materials and the general public along transport routes is limited. Packaging for radioactive materials includes, where appropriate, shielding to reduce potential radiation exposures.

Packages used for the transport of radioactive materials are designed to retain their integrity during the various conditions that may be encountered while they are being transported, thus ensuring that an accident will not have any major consequences. Conditions which packages are tested to withstand include fire, impact, wetting, pressure, heat and cold.

14.3 Research Strategy

There is a continuing need to understand the limitations and uncertainties inherent in techniques, methods, underpinning assumptions and evidence that are used to support the safe transport of radioactive material around the UK and abroad. The research strategy aims to achieve the regulatory objectives highlighted above by promoting and staying informed on relevant dutyholder and international research programmes.

15 NUCLEAR FUEL RESEARCH

15.1 Introduction

Nuclear fuel rods, or pellets of fuel material, are clad in metal to form individual fuel rods which provide containment for the fuel. As the fuel is consumed, the fissile material content is slowly transformed into fission products. These fission products include hazardous radioactive isotopes which must be immobilised as far as reasonably practical. Most of the fission products remain trapped in the fuel material itself, but a fraction diffuses out of the pellets and is retained by the metal cladding tube. The main focus of fuel research is to maintain the integrity of the fuel rods.

The fuel rods are fabricated into self-contained fuel assemblies to allow the fuel to be handled and the correct core geometry to be maintained. The design and dimensions of the fuel rods and assemblies are determined by the requirements of the particular reactor.

The design of fuel assemblies aims to maximise the fuel assembly power density and discharge irradiation, subject to the constraints of safe operation. These constraints require adequate heat removal from the fuel rod and limited release of hazardous isotopes from the fuel material.

Heat removal from the fuel surface is ensured by maximising the coolant flow, subject to constraints, such as flow-induced fretting wear.

Release from the fuel material is limited by constraints on power density and discharge irradiation, together with optimisation of the fuel geometry and material composition.

It is also necessary to consider whether actions can be taken to limit fuel damage in normal operation and fault conditions.

For AGR fuel, carbon deposition problems have led to fuel failures in service, leading to the licensee developing mitigating strategies such as the injection of Carbonyl Sulphide (COS) into the reactor coolant circuit. The long-term effects on fuel clad and other fuel components, e.g. graphite sleeve and tie bars, of exposure to COS will be a continuing research focus.

Within the UK, as reprocessing of spent nuclear fuel is due to cease by circa 2018, long-term performance of the fuel cladding in stored PWR and AGR nuclear fuel (in a variety of storage media e.g. helium, demineralised water, water at an alkali pH etc.) is becoming of increasing interest.

Current topics being considered for research include:

- The effects of high burn-up rates (extended fuel irradiation periods);
- The introduction of new materials in the fabrication of fuel assemblies;
- The establishment and maintenance of suitable safety criteria for the deployment of nuclear fuel within the reactor;
- Ensuring adequate understanding of the issues regarding subsequent storage, retrieval and reprocessing or geological disposal of the used fuel assemblies; and
- The feasibility of fuel designs with increased accident tolerance.

The scope of this section is limited to understanding the behaviour of nuclear fuel with respect to the safe operation of nuclear facilities under normal and fault conditions. This includes the production of radionuclides in gas-cooled reactors either as fission products or as activation products, how these may reach the external environment during normal operation or reactor faults, their dispersion in the environment and the associated radiological consequences.

15.2 Regulatory Challenges and Opportunities

Research in nuclear fuel topics (including radionuclides and radiation protection) has reached a level of maturity; therefore, the primary regulatory challenge is to ensure that an adequate and balanced programme of nuclear safety research matters continues to be carried out. Such a programme should be based on issues that are still relevant in this field, e.g. PWR fuel behaviour at high burn-up, the extent of radionuclide retention that limits eventual release to the environment and other developments associated with the use of novel materials. Further work is also needed on validation and the associated safety margins of current analytical methods.

ONR also wishes to take the opportunity to benefit from data and information produced by others; i.e. following the good practice recommended by the IAEA International Nuclear Safety Advisory Group (INSAG) in their report 'Basic Safety Principles for NPPs - INSAG 12' that the results of research relevant to safety are exchanged, reviewed and analysed, and that the lessons are learnt and acted on. In the case of PWR, an important source of safety-related information is international data on operational experience feedback (OEF) and the outcome of international research projects.

15.3 Regulatory Objectives

ONR needs to acquire sufficient knowledge to form an independent view on the suitability of safety submissions proposing changes to fuel designs and operating limits, for long-term storage facilities for spent nuclear fuel and to be able to determine which potential safety measures are reasonably practical.

History has shown that developments in the fuel area need to be evolutionary, with adequate experimental substantiation and with data from full-scale integral testing. Some key topic areas are discussed briefly below.

15.3.1 Fuel Rod Internal Pressure

Some of the fission products are gaseous and the small fraction that diffuses out of the fuel pellets can lead to a gradual pressurisation of the rods. This increases stress on the metal cladding of the rods and must be limited to prevent cracking of the cladding. The need to limit cladding stress places significant safety requirements on reactor power levels and subsequent storage and/or reprocessing. Efforts have been made, both in the UK and internationally, to provide increased safety margins and these continue.

In AGRs, the constraints placed on pin internal pressures play a major role in limiting the risk posed by the reactors under potential fault conditions, and EDF NGL has recently modified its fuel design to reduce the peak fuel pellet centre temperature and to accommodate more fission product gas. ONR is monitoring the performance of this fuel in reactor via the EDF NGL's routine programme of Post-Irradiation Examination.

Internationally, fuel suppliers have been adding dopants to the fuel material to increase the grain size and hence to reduce the rate of diffusive release of fission products. Initial indications are that these changes are not detrimental to other aspects of the fuel performance and ONR is monitoring this as information becomes available. Fuel suppliers have been making the data available at international meetings and independent data will be obtained as a result of collaborative programmes.

The ability of the fuel cladding to resist the stresses depends on its metal condition and significant amounts of research are underway internationally to examine the endurance of irradiated

cladding during storage and to further substantiate operating limits. Data for water reactor type fuel is available through engagement in international collaboration.

15.3.2 Constraints on Heat Removal

Heat removal from the fuel is limited by the limits on coolant flow rates imposed by flow-induced vibration. History has shown that the best approach to setting these limits is full-scale integral testing, supplemented by analysis and pilot fuel loading. However, it is necessary to account for changes in fuel assembly geometry that may occur during irradiation.

ONR is aware that detailed analytical models are being developed, and this will be monitored as a means of extrapolating experimental data, but active involvement is not currently planned.

Ideal performance of the fuel can be inhibited by the deposition of solid material onto the fuel surface. Again, there are programmes of research underway internationally. ONR continues to monitor this area and engage with the relevant dutyholders as appropriate.

15.3.3 Accident Performance

The performance of fuel in postulated accidents needs to be considered not only to limit the likelihood and extent of fuel damage, but also to understand the processes leading to the release of fission products from the fuel.

EDF NGL has carried out innovative analytical work in this area in the past and continues to address this area, including modelling fuel pins in some detail.

Internationally, significant work is underway to examine the processes leading to damage to fuel in the event of accidents involving the drainage of fuel storage ponds. This will be a useful test of severe accident analysis methods and may enable conclusions to be made on mitigation strategies.

15.4 Research Strategy

For AGR fuel assemblies, acquisition of experimental and post-irradiation examination (PIE) data will remain a high priority to further underpin understanding and the validation of fuel performance codes.

Research activities relating to PWR fuel issues are expected to continue with an emphasis on fuel behaviour under normal, transient and fault conditions, e.g. PWR fuel and clad changes associated with high burn-up. The main faults of interest at high burn-up include reactivity insertion accidents (RIA), loss of coolant accidents (LOCA) and those resulting in departure from nucleate boiling.

International work has shown a fuel pellet rim effect and pellet micro-cracking in fuel irradiated to high levels. This will have consequences for pellet temperature distribution and hence swelling and fission gas release. The rim effect during both normal and fault conditions is a safety issue requiring further research. Other factors which may be affected by increased fuel burn-up include Pellet Clad Interaction (PCI), clad mechanical properties, fuel thermal conductivity and enhanced fission gas release.

Steady-state data on fuel performance of a variety of standard and novel materials at high burn-up have been supplied by the OECD Halden Project. Prototypic RIA transients cannot be performed in Halden, but this is addressed by the CABRI project on high burn-up fuel behaviour under very fast transient conditions. LOCA experiments are carried out at Halden and as part of Studsvik Cladding Integrity Project (SCIP).

The OECD/CSNI/PWG2 Task Force on Fuel Safety Criteria (TFFSC) was given a mandate to review the existing fuel safety technical criteria, focusing on new fuel and core design, cladding materials, manufacturing processes, high burn-up, MOX, etc., introduced by the industry. It had to identify if additional efforts were required (experimental, analytical) to ensure that the basis for fuel safety criteria was adequate to address relevant safety issues. The Task Force concluded that the current framework of fuel safety criteria remains generally applicable, being largely unaffected by the 'new' or modern design elements. However, the levels (numbers) of individual safety criteria may change in accordance with the particular fuel and core design features. Some of these levels have already been, or are continuously being, adjusted; level adjustments of several other criteria (RIA, LOCA) also appear to be needed on the basis of experimental data and the analysis thereof.

OECD Working Group on the Analysis and Management of Accidents Group (WGAMA) and the Working Group on Fuel Safety (WGFS) provide a watching brief on fuel research from around the world.

ONR is also keeping a watching brief on international developments in long-term management of spent fuel to augment current understanding.

15.5 Technical Research Capability

While understanding of relevant radiological protection issues is essential, these issues are not unique to the nuclear industry. A number of organisations can give authoritative and independent advice, in particular Public Health England (formerly the Health Protection Agency). Similarly, ongoing access to expertise on fission product chemistry and particulate behaviour is required, but such expertise is not unique.

PWR fuel advice is available worldwide. There are limited independent sources of Magnox and AGR fuel advice in the UK. The UK regulator is in regular contact with the IAEA and other international regulators.

In-house teams are currently maintained by the major civil nuclear reactor licensee (EDF NGL). They are engaged on maintenance and validation of key UK codes, as well as further refinement of these codes. These teams have access to experimental facilities and sources of information through participation in international programmes such as the OECD Halden Reactor Project. EDF NGL is extending their research capability by co-funding a doctoral fellowship on AGR and PWR fuel issues at Imperial College.

There is also a requirement for the UK to maintain and develop subject matter experts to respond to emerging issues around new build and the associated fuel cycle infrastructure.

15.6 International Activities

EDF NGL subscribes to membership of the following international agencies and programmes which gives it access to international research programmes:

- EPRI membership gives access to data from ongoing LWR fuel research programmes;
- NFIR - Nuclear Fuel Industries Research - this group sponsors research on LWR fuel. Topics such as high burn-up fuel structure fragmentation and fission gas release are seen as being generically important. The emphasis is on fuel, rather than cladding research;
- The OECD Halden Project - the focus of this programme is on extended fuel utilisation, degradation of core materials and man-machine interfaces. The programme is renewed every three years. The last renewal was in 2008. UK ONR is a signed up member. EDF NGL

participates directly in this project, thereby gaining access to the results of collaborative research programmes on fuel;

- OECD-HRP Summer School – EDF NGL supports this annual event organised by the Halden Reactor Project. The Summer School is aimed at young professionals at the beginning of their career and at people who are not specialists in fuels behaviour, but who would like to obtain some basic information and knowledge about the subject;
- CABRI - Membership of the CABRI experimental programme on fuel safety/PWR RIA tests is funded by industry, through ONR. The regulator also attends annual project meetings;
- NEA Databank – EDF NGL has collaborated with NES by releasing the results of its fuel swelling research programme to the International Fuel Performance Experiments (IFPE) Database. The most recent benefit to EDF NGL was fundamental steam data obtained from the programme;
- TUG - a six monthly meeting of Nuclear Fuel Engineers from many European utilities to exchange information primarily in the area of fuel performance;
- Fuel Vendor Customer Information Meetings - in addition to a bi-annual meeting between the fuel vendor and customers, EDF NGL continually obtains technical information on fuel developments and technical areas of concern;
- FUMEX - this is an OECD/NEA program that focuses on fuel performance code comparison/benchmarking that allow participants to 'blind' test their codes against the same input data and compare their code against others. EDF NGL has signed up to FUMEX III as this will be a good opportunity to test the latest version of ENIGMA; and
- SFP (Sandia Fuel Project) - investigates ignition phenomena in spent fuel assemblies after a postulated complete loss-of-coolant accident in spent fuel pool. The project aims to perform a highly-detailed thermal hydraulic characterisation of full-length, commercial fuel assembly mock-ups to generate data for the validation of severe accident codes.

15.6.1 Current International Forums

EDF NGL and ONR also routinely send delegates to fuel related international conferences to gain information first hand and develop/maintain experience, and subscribe to a number of conference reports.

The following international activities have also been identified as being potentially important to continuing fuel safety:

- WGAMA OECD WG - Organisation for Economic Co-operation and Development Working Group on the Analysis and Management of Accidents: this essentially provides a watching brief on internationally collaborative projects, including severe accidents;
- WGFS - The Working Group on Fuel Safety addresses issues related to fuel behaviour in accident conditions, including work on associated aspects of thermal-hydraulics, oxidation, chemistry, mechanical behaviour and reactor physics;
- SCIP - Studsvik Cladding Integrity Project: this programme investigated clad integrity, but now also includes Loss of Coolant Accident (LOCA) testing for the US-NRC;
- IAEA Spent fuel storage and data: this programme is providing useful feedback and contacts, for instance the Guidance Document on Storage of Spent Fuel;

- ROSA - OECD Rig of Safety Assessment Project: this is a Japan-based PWR thermal hydraulics project that could be useful for Sizewell B. The second phase of the programme (ROSA-2) will be completed later this year; and
- SARNET – Severe Accident Research Network is a working group in which members collaborate to develop analytical methods for the prediction of reactor response to severe accidents. A number of academic establishments within the UK collaborate with this effort, including the development of detailed models of fuel melting and relocation.

16 CIVIL NUCLEAR SECURITY

16.1 Introduction

Effective security arrangements in the civil nuclear industry are essential to prevent the theft or sabotage of nuclear or other radioactive materials, the sabotage of nuclear facilities and to protect sensitive nuclear information. This is regulated by ONR through the Civil Nuclear Security Programme. In ONR, security is sub-divided into the broad topics of physical protection (including site and nuclear material transport), personnel security and information security. The obligations placed upon all those involved in security in the civil nuclear industry are laid down in the Nuclear Industries Security Regulations 2003 (NISR 03), as amended.

Security in the civil nuclear industry reflects the UK's international obligations and best practice. In particular, the UK is a party to the Convention on the Physical Protection of Nuclear Material and takes account of the recommendations made by the International Atomic Energy Agency (IAEA) in its document, The Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev5).

Research is necessary to assess and assist selection of the most appropriate security measures to deliver the necessary level of security in the civil nuclear industry.

16.2 Regulatory Challenges and Opportunities

Research in physical site protective security and personnel security has reached a degree of maturity, although wider changes such as in technology and geo-political factors mean that the threats to security in these areas are still evolving. This is also true in the field of information security; however the degree and speed with which change occurs is far greater due to the rapid changes and advances in information technology.

ONR has well-established links with the UK security research bodies, which enable it to stay abreast of research developments. ONR security inspectors have access to, and are able to assess, this research; where necessary they can consider commissioning additional research. ONR's security research requirements are similar to those experienced by other sectors in the critical national infrastructure and it is often the case that research commissioned by one body can be used by others. Where activity can benefit all areas of the critical national infrastructure, the Centre for the Protection of the National Infrastructure (CPNI) normally takes the lead.

With respect to civil nuclear industry matters, ONR security inspectors monitor the following in order to identify challenges and opportunities:

- Assessment of security notifications and submissions seeking approvals;
- Operational experience, including inspection;
- Effects of ageing;
- Periodic security reviews;
- Incidents (domestic and international);
- Changes in policy or direction;
- The implications of emerging technical developments and innovations;
- The longer-term industry response to the recently issued National Objectives, Requirements and Model Standards (NORMS);

- Long-term implications of operating experience and incidents;
- Longer-term business plans of the licensees and operators;
- New information, views or practices (e.g. domestic and international meetings and conferences);
- Domestic and international co-operation (nuclear and non-nuclear industries);
- Access by dutyholders and regulators to technical capability; and
- Implications and application of international developments in nuclear security.

16.3 Regulatory Objectives

ONR-CNS programme regulatory objectives include the following:

- Improved site security;
- The continued validity of security submissions for approval by ONR-CNS, such as Nuclear Site Security Plans;
- Proportionate and appropriate levels of security at sites and in transit;
- Improved methodologies and data on security at sites;
- Security "designed in" from the start for nuclear new-build sites;
- Enhanced security culture at sites;
- The upgrade/replacement of site security due to ageing/improved technology;
- The investigation of incidents; and
- A proactive approach to emerging issues.

16.4 Research Strategy

Research activities relating to security matters in key areas of the UK infrastructure, including nuclear sites, are expected to continue being driven by other government bodies with greater primacy in security research. ONR intends to continue its well-established and effective close liaison with these bodies through the Civil Nuclear Security programme. Where ONR identifies focus for nuclear-specific security research that is not being actively considered by others, then ONR will look at how the necessary research can be most efficiently and effectively commissioned and undertaken.

There is an ongoing need to maintain close liaison and a watching brief in the areas of nuclear safety and engineering where these may have an impact on security.

16.5 Technical Research Capability

Research and testing of security procedures and equipment is undertaken under the auspices of the CPNI. The Home Office's Centre for Applied Science and Technology (CAST), which has close links with academia and industry and provides advice on security matters, also undertakes security research when contracted to do so. For 2013/14 it is assessed that no security research needs be commissioned by ONR.

16.6 International Activities

ONR routinely sends delegates to security-related international conferences to obtain information on international research activities. ONR also participates in International Physical

Protection Advisory Service (IPPAS) missions which afford a further opportunity to undertake a detailed assessment of physical security in other countries.

IPPAS missions also allow ONR-CNS the opportunity for influencing international collaboration as well as improving security standards internationally.

17 NUCLEAR SAFEGUARDS

17.1 Introduction

Nuclear safeguards are measures used to verify that countries comply with their international obligations not to misuse nuclear materials (essentially all forms of plutonium, uranium and thorium) for nuclear explosives purposes. Since the State itself is regarded as the potential diverter of nuclear material, confidence about the absence of diversion is provided by external, i.e. international, verification. Global recognition of the need for such verification is reflected in the requirements of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) for the application of safeguards by the International Atomic Energy Agency (IAEA). Also, the Treaty Establishing the European Atomic Energy Community (the Euratom Treaty) includes requirements for the application of safeguards in the European Union by the European Commission. International safeguards are distinct from, but have synergies with, nuclear safety measures and arrangements for nuclear security and physical protection.

The primary safeguards 'regulators' are the international safeguards inspectorates. Nevertheless, safeguards obligations in the UK are a direct consequence of the UK Government's signature of Treaties and Safeguards Agreements, and the role the ONR Safeguards function is to:

- Provide the UK Government with informed independent assessment of safeguards application and compliance in the UK, including being in a position to support and intervene as necessary with the international safeguards inspectorates of the European Commission and the IAEA and/or UK organisations subject to safeguards requirements, so that safeguards obligations for the UK are met in a proportionate manner. This includes reporting within HSE and to the Department of Energy and Climate Change (DECC) on safeguards inspection activities in the UK, their follow-up and key issues as they arise;
- Fulfil the international and domestic safeguards-related reporting obligations that are the direct responsibility of the UK Government (as opposed to nuclear operators in the UK); and
- Provide advice and support to DECC and other Government Departments (OGDs) on safeguards implementation in the UK, the effectiveness of regulation and associated policy development.

17.2 Regulatory Challenges and Opportunities

The work of the ONR Safeguards function includes:

- Influencing improvements to ensure UK organisations have an excellent safeguards culture and supporting arrangements for nuclear materials accountancy (NMA); and
- Contributing to ONR's reputation as a world-leading independent nuclear regulator. Although ONR is not the safeguards regulator good safeguards performance, as assessed by the international inspectorates, is important to the reputation of the UK and ONR. ONR's safeguards role includes helping to ensure such performance by maintaining credible, professional, effective and independent involvement in safeguards implementation in the UK.

17.3 Regulatory Objectives

The three main external delivery objectives for the ONR Safeguards function follow from the role described above:

- Effective, efficient and proportionate safeguards implementation in the UK by the European Commission and the IAEA;
- Submission and/or publication of the information required of the UK Government in respect of its international and domestic safeguards-related reporting obligations; and
- Provision of specialist safeguards advice, support and reporting to DECC and other Government Departments on safeguards implementation in the UK, the effectiveness of regulation and associated policy development.

17.4 Research Strategy

The Nuclear Safeguards Programme (NSP) forms a key part of the UK contribution to the international safeguards regime and to IAEA's R & D programme. Its principal aims are:

- To assist the IAEA in ensuring the continued and improved effectiveness of its safeguards system and to influence the formulation of technical safeguards policy in the IAEA;
- To assist the UK in meeting its obligations under the NPT and the Euratom Treaty in as cost-effective a manner as possible; and
- To assist in the formulation of UK policy on safeguards and non-proliferation issues.

The NSP is funded by the UK DECC and is administered on its behalf by the National Nuclear Laboratory (NNL). A range of contractors undertake R & D on behalf of the programme, which is divided into two main parts: the UK Support Programme to the IAEA (UKSP) and a programme of safeguards support to DECC.

ONR works closely with DECC on safeguards matters and does not need to compete with, or add to, the DECC-funded safeguards R&D work of the UKSP.

Further details of the UK safeguards support programme projects can be found on the DECC web pages of the www.gov.uk website. The latest UKSP report is available at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65519/6403-uk-safeguards-support-report-2011-12.pdf

17.5 Technical Research Capability

Part I of the Nuclear Safeguards Programme provides technical support to the Department of Safeguards of the IAEA in verifying the peaceful use of nuclear technology. The UK Support Programme contributes:

- Expertise and advice for the further development of safeguards strategies in new and existing activities and plant in the nuclear fuel cycle;
- Services to support the IAEA in analysing nuclear material arising from samples taken in the course of safeguards inspections;
- Access to facilities and experts for the training of Agency personnel in advanced techniques applied in safeguards inspections and on fuel cycle plants;
- Development of techniques, methods and procedures for safeguarding facilities in the nuclear fuel cycle;
- Development and assessment of equipment, instruments and methods for application in safeguarding the nuclear fuel cycle; and

- Assistance through the provision of expert staff to complete specialised programmes of work that cannot be resourced through a permanent position with the IAEA.

Part II of the Nuclear Safeguards Programme provides a programme of technical support directly to DECC.

17.6 International Activities

The UK Support Programme was initiated by the UK Government in 1981, with the following formal objectives:

- To assist the IAEA in the provision of efficient and effective solutions to identified safeguards needs as set out in the IAEA's Safeguards Research and Development (R&D) Programme;
- To provide the IAEA with essential services and training which are not commercially available or cannot be provided from the Agency's own resources;
- To develop techniques and methods for safeguarding facilities in the fuel cycle, particularly reprocessing plants and enrichment plants;
- To develop techniques and methods for the application of safeguards in general situations; and
- To provide the IAEA with cost-free consultancy, particularly on systems analysis.

Assistance is provided to the IAEA Department of Safeguards in six areas of technical support:

- Safeguards Strategies;
- Support for IAEA Analytical Services;
- Training Courses;
- Safeguards Procedures;
- Instrument Development and Assessment; and
- Consultants and Cost-Free Experts.

18 ENVIRONMENT AGENCIES

18.1 Introduction

The Environment Agency, SEPA and Natural Resources Wales (collectively referred to here as the 'environment agencies') welcome the opportunity to contribute to the Office for Nuclear Regulation's Nuclear Research Needs (NRN). The following statement provides information concerning the research priorities of the environment agencies regarding radioactive substances regulation for nuclear sites. It is anticipated that a more comprehensive submission will be provided for 2014.

18.2 Regulatory Objectives

The environment agencies wish to see that decision making in areas pertinent to their regulatory responsibilities is based on sound evidence. Establishing the evidence base will sometimes require research to be carried out. The areas of radioactive substances research in which the environment agencies have an active or potential interest are:

- Decommissioning and Clean-up – as the current generation of nuclear power plants and other nuclear research sites are decommissioned and sites are cleaned-up, the environment agencies need information on best practice and performance for different techniques that may be employed to ensure ongoing environmental radiation protection and the application of best available techniques (BAT);
- Emissions and Discharges – a broad range of research requirements with projects covering many issues regarding planned discharges to air and water from licensed nuclear sites.
- Disposal – geological and near surface disposal in England and Wales and near surface in Scotland. Disposal facilities will have to consider potential impacts to the environment from possible releases which may occur as part of the operation of the facility, and post-closure evolution. Research is needed to enable the environment agencies to assess and advise on proposals for such facilities;
- Land Quality – radioactive land contamination is potentially regulated by the environment agencies, should it be determined as 'contaminated land' under the regulatory regime for contaminated land set out in Part 2A of the Environmental Protection Act 1990. Wider impacts from the migration of contaminants and from the management of radioactive wastes produced during site remediation are also of interest to the environment agencies. Future requirements include research to better understand the fate of radioactive contaminants in soil and groundwater and groundwater protection methods;
- Nuclear New-Build (England and Wales only) – the proposed new generation of nuclear power reactors planned for England and Wales will require some additional information and assessment work to understand the range of environmental impacts, particularly on whether the production and management of radioactive wastes represents BAT;
- Radiological Assessment – the environment agencies maintain various tools to assist radiological assessments, which require periodic updating. A further research requirement concerns internal emitters and uncertainties related to their assessment; and
- Waste – assessment of potential releases of radioactivity to the environment from the management of radioactive waste is an important area requiring further research and assessment of techniques. Research priorities include waste minimisation, long-term storage integrity to prevent releases and abatement of releases.

18.3 Research Strategy

The environment agencies' research interests are progressed via a range of approaches, particularly:

- partnership with organisations such as the Natural Environment Research Council (NERC), the Nuclear Decommissioning Authority (NDA), universities or via funds recouped from industry under legal agreements for the provision of advice, or through normal regulatory charges;
- research being carried out directly by the environment agencies, but with costs charged to the relevant nuclear operator or operators; and
- through specifying, in permit improvement conditions, activities the permit holder must undertake within a specified timeframe.

For future versions of the NRN the environment agencies intend to explore how they might use the format of the NRN to set out their views of the research landscape of interest to them, explaining where further research is required.