

RADIOACTIVE WASTE MANAGEMENT AND DECOMMISSIONING IN THE UNITED KINGDOM

1. NATIONAL FRAMEWORK FOR MANAGEMENT AND REGULATION OF RADIOACTIVE WASTE AND DECOMMISSIONING

1.1 National framework

1.1.1 Overview of national policy

Government policy is to protect the population, society and the natural environment from harmful levels of radioactivity through adequate and appropriate national measures whether deriving from European Union directives and regulations, international agreements or domestic legislative initiatives.

The policy for the management of radioactive waste is devolved in the UK to the Scottish, Welsh and Northern Ireland governments. The UK Government is responsible for policy in England. The term “the Government” is used where statements apply to all four governments.

There are specific policies for long-term management of high activity radioactive waste, management of low level radioactive waste, radioactive waste discharges and decommissioning.

1.1.1.1 Long-term management of higher activity radioactive waste

The Managing Radioactive Waste Safely White Paper, published in June 2008 by the UK, Welsh and Northern Ireland governments, sets out how the government policy of geological disposal of higher activity radioactive waste will be implemented, including safe and secure interim storage up until disposal. It describes the technical programme to design and deliver a geological disposal facility and the process and criteria to be used to decide the siting of a facility.

The White Paper was accompanied by an invitation to communities to express an interest in entering into without commitment discussions with the UK Government about the possibility of hosting a geological disposal facility for higher activity radioactive waste at some point in the future. Three local authorities, all based in West Cumbria, have made such an Expression of Interest¹. The invitation is still open.

In the 2008 White paper the Welsh Government reserved its position on the policy of geological disposal while continuing to play a full part in the Managing Radioactive Waste Safely programme in order to secure the long term safety of radioactive wastes, to ensure the implementation of a framework appropriate to the needs of Wales and to ensure that the interests of Wales are taken into account in the development of policies in this area.

The Scottish government did not sponsor the MRWS White Paper and has developed its own policy, which it published in January 2011. The Scottish Government Policy is that the long-term management of higher activity radioactive waste should be in near-surface facilities. Facilities should be located as near to the site where the waste is produced as possible. Developers will need to demonstrate how the facilities will be monitored and how waste packages, or waste, could be retrieved.

1.1.1.2 Management of low-level radioactive waste

The current UK policy for managing solid LLW was published by the UK Government and Devolved Administrations in March 2007. The overall aim of the Policy was to set out the need for greater flexibility

¹ Further information and a copy of the White Paper can be found at <http://mrws.decc.gov.uk>.

in managing LLW, recognising that previous Government policy was not developed to take account of large scale decommissioning and environmental restoration.

The policy sets out a number of principles:

- use of a risk-informed approach to ensure safety and protection of the environment
- minimisation of waste arisings (both activity and volume)
- forecasting of future waste arisings, based upon fit for purpose characterisation of wastes and materials that may become wastes
- consideration of all practicable options for the management of LLW
- a presumption towards early solutions to waste management
- appropriate consideration of the proximity principle and waste transport issues
- in the case of long term storage or disposal facilities, consideration of the potential effects of future climate change.

The Policy also sets out a number of requirements for the NDA, including development of a UK nuclear industry LLW strategy, developing a plan for the optimum use of LLWR and making NDA LLW management facilities available to other nuclear and non-nuclear managers of radioactive waste.

The NDA published its UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry in August 2010².

1.1.1.3 Radioactive waste discharges

In the UK, the policy on the regulation of radioactive waste discharges and disposals, was for many years, governed by two optimisation concepts: Best Practicable Environmental Option (BPEO) and Best Practicable Means (BPM). The progressive reduction of discharge limits and of actual discharges, having regard to the application of BPM, was a central tenet of the way in which radioactive discharges were controlled, and a feature of UK policy since 1993.

In July 2009, the UK Government published statutory guidance to the Environment Agency that replaced BPEO and BPM in England and Wales with Best Available Techniques (BAT) in the optimisation of doses and the setting of discharge limits³. The UK and Welsh Governments consider that a move to this approach will deliver a regime that is more consistent with the terminology of the OSPAR Strategy and other environmental protection regimes. The application of BAT will deliver the equivalent level of environmental protection as achieved, until now, by the use of BPM and BPEO. The Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA) are continuing to apply BPM and BPEO in the regulation of radioactive discharges in Scotland and Northern Ireland.

The revised UK Radioactive Discharges Strategy published in July 2009 updates and broadens the scope of the 2002 Strategy. It forms the UK's national report to the OSPAR Convention on how the UK will meet its commitment to achieve the objectives of the OSPAR Radioactive Substances Strategy (RSS). In particular, the revised Strategy sets out the progress made since 2002, and describes how the UK will meet the RSS intermediate objective that by 2020 discharges, emissions and losses of radioactive

² NDA, UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry, August 2010. Available at: <http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-August-2010.pdf>

³ The Statutory Guidance is available at http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/government/disc_harges/strategy/strategy.aspx

substances are reduced to levels where the additional concentrations in the marine environment above historic levels are close to zero.

1.1.1.4 Decommissioning

In September 2004 the UK Government and the devolved administrations issued a statement of policy on the decommissioning of nuclear facilities⁴. Key points of this policy are noted below.

The objective of decommissioning is to remove progressively the hazard that the facility poses. Decommissioning operations should be carried out as soon as reasonably practicable, taking all relevant factors into account.

Each operator produces and maintains decommissioning strategies and plans for its sites. The strategies and plans should take into account the views of stakeholders (including relevant local authorities, public and stakeholder groups). The strategies should take into account all relevant factors, assessing and presenting them in a transparent way, underpinned by objective information and arguments, and robust cost estimates. These include:

- ensuring worker and public safety;
- maintaining site security;
- minimising waste generation and providing for effective and safe management of wastes which are created;
- minimising environmental impacts including reusing or recycling materials whenever possible;
- maintaining adequate site stewardship;
- using resources effectively, efficiently and economically;
- providing adequate funding;
- maintaining access to an adequate and relevant skills and knowledge base;
- using existing best practice wherever possible;
- conducting research and development (R&D) to develop necessary skills or best practice; and
- consulting appropriate public and stakeholder groups on the options considered and the contents of the strategy.

The future use of the site, once decommissioning operations are completed, is a significant factor in determining decommissioning operations. The objective is to get the best solution overall taking into account the needs of the environment, and the safety of workers and the local community.

Strategies harness the general benefits of radioactive decay while the problems to which it may give rise in certain areas are avoided. They seek to avoid the creation of radioactive wastes in forms that may reduce the number of options for safe and effective long-term waste management. The use of BPM strategies minimises the volumes of radioactive wastes created, particularly the volume of ILW.

Where short-term increases in discharges of some radionuclides are unavoidable, the relevant environment agency must be satisfied that they represent the optimal result from appropriate option studies and reflect the application of the BPM and as low as reasonably achievable (ALARA) principles.

Operators review their strategies periodically and when changes in circumstances, including relevant Government policies, make this necessary.

⁴ The Decommissioning of the UK Nuclear Industry's Facilities, September 2004
<http://webarchive.nationalarchives.gov.uk/+http://www.berr.gov.uk/files/file30124.pdf>

The operators of sites for which NDA is responsible are also required through their contracts with NDA to produce plans covering the whole lifecycle of these sites, including their decommissioning.

1.1.2 Overview of relevant institutions

1.1.2.1 Department of Energy and Climate Change

The Department of Energy and Climate Change (DECC) was created in October 2008, bringing together energy policy (previously with the Department for Business, Enterprise and Regulatory Reform (BERR)) with climate change mitigation policy (previously with the Department for Environment, Food and Rural Affairs (Defra)). DECC is the lead government department responsible for the development and implementation of nuclear policy, covering current and future nuclear installations in the UK as well as dealing with the legacy of nuclear generation. It delivers its responsibilities through a combination of non-departmental public bodies and regulators, by being party to international agreements and through the use of agreed industry processes.

1.1.2.2 Devolved Administrations

Scottish, Welsh and Northern Ireland Governments have responsibility for radioactive waste management policy in the relevant countries.

1.1.2.3 Health and Safety Executive (HSE) and the Office for Nuclear Regulation (ONR)

HSE is responsible for enforcing legislation on health and safety at work.

In February 2011, the UK Government announced its intention to bring forward legislation to create a new independent nuclear regulator, the Office for Nuclear Regulation (ONR). ONR, which was formed on 1 April 2011 as an Agency of the HSE, will function as a sector-specific regulator of the nuclear industry. It has taken on the relevant functions previously carried out by the HSE's Nuclear Directorate and the Department for Transport's Radioactive Materials Transport Team, which is responsible for the transport of radioactive material by road, rail or inland waterway, thereby bringing together civil nuclear and radioactive transport safety and security regulation into one place. As an interim measure and until the legislation can be enacted, ONR will operate as an Agency of the HSE. When the legislation comes into force (expected to be in April 2013), the ONR will become a separate statutory body and will be formally responsible in law for delivering its regulatory functions.

The changes to the regulatory body will not affect the current regulatory requirements or standards with which the nuclear industry must comply.

1.1.2.5 The environment agencies

The Environment Agency was established in 1996 to provide environmental protection and improvement in England and Wales, including the regulation of radioactive waste disposal. It is a non-departmental public body, sponsored largely by the Defra and the Welsh Government (WG). The equivalent organisation in Scotland is the Scottish Environment Protection Agency (SEPA) which is sponsored by the Scottish Government, and in Northern Ireland is the Northern Ireland Environment Agency (NIEA), which is part of the Department of the Environment in Northern Ireland.

1.1.2.6 Nuclear Decommissioning Authority

The NDA is a non-departmental public body, established under the Energy Act 2004, responsible for the decommissioning and clean-up of the UK's civil public sector nuclear sites. The NDA is sponsored by the DECC and it is also responsible to the Scottish Ministers in or as regards its sites in Scotland. The NDA is responsible for

- 19 publicly owned civil nuclear sites.
- implementing geological disposal and radioactive waste management solutions, and;
- developing UK-wide nuclear Low Level Waste (LLW) strategy and plans; and
- oversight of British Energy's liabilities arising from its current fleet of nuclear power stations.

1.2 National, technical regulatory organisation(s)

1.2.1 Regulatory function

1.2.1.1 Health and Safety Executive (HSE) and the Office for Nuclear Regulation (ONR)

HSWA74⁵ established two bodies, HSC and HSE, which in 2008 were merged into a new unitary body, bringing together their powers and functions, and retaining the name Health and Safety Executive (HSE). The function of ONR, an Agency of HSE, is to enforce the relevant statutory provisions where it is the enforcing authority. Those parts of NIA65 that concern safety became statutory provisions of HSWA74 in 1974.

The Nuclear Installations Act 1965 etc. (Repeals and Modifications) Regulations 1974⁶ made HSE the nuclear licensing authority for nuclear sites. This authority is delegated to HM Chief Inspector of Nuclear Installations, who is also the Executive Head of ONR. As a result, under NIA65, no site can be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence is currently in force, granted by ONR.

In addition to the responsibilities mentioned above, ONR provides advice on matters within their remit as required, or when requested, to other bodies, government and the public.

ONR takes an active part in international co-operation and development, contributing to international standards, taking part in meetings of European and world regulators, and negotiating and implementing bilateral information exchange agreements with other national regulators.

1.2.1.2 Environment Agency

The Environment Agency was created by the Environment Act 1995 (EA95) with the aim of providing a more integrated approach to protecting and improving the environment of England and Wales as a whole – land, air and water. It is a 'non-departmental public body', sponsored largely by the Defra and the Welsh Government (WG). Its powers and duties relate to environmental protection, flood defence, water resources, fisheries, recreation, conservation and navigation. EA95 sets out the principal aim of the Environment Agency "in discharging its functions so to protect or enhance the environment, taken as a whole, as to make the contribution towards attaining the objective of sustainable development".

1.2.1.3 Scottish Environment Protection Agency

SEPA was established by EA95 to provide environmental protection and improvement in Scotland. Powers under the Radioactive Substances Act 1993 (RSA93) are devolved to the Scottish Government.

⁵ Health and Safety at Work etc. Act 1974 (1974 c.37), <http://www.hse.gov.uk/legislation/hswa.pdf>

⁶ Nuclear Installations Act 1965 etc. (Repeals and Modifications) Regulations 1974, http://www.opsi.gov.uk/SI/si1990/Uksi_19901918_en_1.htm

SEPA is a 'non-departmental public body' whose main source of funding is mainly from Grant in Aid provided by the Scottish Government and SEPA's charging scheme.

Using its statutory powers, SEPA issues various permits, licences, consents, registrations and authorisations covering a wide range of commercial and institutional activities that have the potential for adverse impacts on the environment.

SEPA's main aim is to provide an efficient and integrated environmental protection system for Scotland which will both improve the environment and contribute to the Scottish Ministers' goal of sustainable development.

1.2.1.4 Northern Ireland Environment Agency

The Northern Ireland Environment Agency is an Executive Agency within the Department of the Environment in Northern Ireland. It is the successor of the Environment & Heritage Service (EHS) which was established on 1 April 1996. The NIEA was launched on 1 July 2008 pursuant to a Ministerial decision that the EHS would be reorganised into the NIEA.

NIEA issues various permits, licences, consents, registrations and authorisations covering a wide range of commercial and institutional activities that have the potential for adverse impacts on the environment

The aim of NIEA is to protect, conserve and promote the natural environment and built heritage for the benefit of present and future generations. It provides scientific and technical advice on the development of legislation and policy.

1.2.2 Organisation and resources

1.2.2.1 Office for Nuclear Regulation (ONR)

Organisation

The original Nuclear Installations Act, enacted in 1959, set up the Nuclear Installations Inspectorate (NII) in 1960, then called the Inspectorate of Nuclear Installations. The 1959 Act was subsequently replaced by NIA65 which, although amended in some details, retains essentially the same regulatory powers. In 1974, NII was incorporated into HSE, and those parts of NIA65 relating to licensing became relevant statutory provisions of HSWA74. On 1 April 2011 NII became part of the Office for Nuclear Regulation (ONR), an Agency of HSE.

ONR operates the nuclear site licensing system under NIA65 and grants licences to corporate bodies to install or operate a nuclear installation on a particular site. ONR may attach to a nuclear site licence such conditions as appear necessary or desirable in the interests of safety, or such conditions as it may think fit with respect to the handling, treatment and disposal of nuclear matter.

As at 1 April 2011, ONR is organised into seven divisions covering:

- Regulation of Nuclear Power Plants (NPPs) (operating and decommissioning);
- Regulation of fuel manufacture, fuel reprocessing, research facilities, waste management and the UK Safeguards Office;
- Regulation of Ministry of Defence related sites;
- Strategy development, planning and finance;
- Regulation of Security at licensed nuclear sites;
- GDA; and
- Corporate Affairs and Strategy.

Each Division also has administrative support.

ONR operates in accordance with a Business Management System (BMS) to provide an integrated approach to system management, thereby ensuring that the system adds value to internal processes, and clarifies the responsibilities of its staff. The BMS has been designed to document appropriate policies,

management controls and process controls in a manner that augments the experience, training and professional judgment of all staff. This is reflected in the systems Key Business Activity areas. The system is a living one, being regularly updated as experience of its use is gathered and fed back to improve systems where shortfalls are found.

Within the BMS, procedures and guides of ONR's key processes (key business activities) are documented in a consistent manner. The activity-based approach ensures that the documentation adapts easily to accommodate re-organisations or changes in organisational focus. The system includes a means for continuous improvement. Audit, review and use of specified monitoring tools (e.g. the European Foundation for Quality Management Excellence Model), ensures that the focus on processes maximises the efficiency and effectiveness of efforts towards meeting ONR's aspirations.

Financial resources

Section 24A of NIA65 enables financial charges to be imposed on the nuclear licensees to recover the expenses incurred through ONR's regulation of nuclear installations. In addition, further expenses are recovered from licensees in respect of a programme of safety research and studies agreed between ONR and the industry. ONR uses a work recording system to identify the effort and expenses of its staff attributable to each licensee.

Additionally, Fees Regulations are used to recover charges for work on GDA. In 2010/11, ONR's total expenditure forecast is £51 million, of which nuclear inspection expenditure is forecast to be £48 million (excluding central overheads).

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Human Resources

As of 30 April 2011, ONR has 218 nuclear safety inspectors in post and 2 in training. It has sufficient inspectors in post to carry out its current regulatory duties but it is recognised that recruitment will need to continue at the same rate for several years to address further developments in the industry and as older inspectors retire. As in many other countries, ONR's age distribution is heavily weighted towards the older end of the spectrum and it currently has many inspectors in post who are beyond the former retirement age of 60 years old (at present around 13% are over 60 and 30% over 57). However, the Government has recently removed all age barriers so there is now no upper age limit to employment.

Staffing profiles have been prepared for a number of years ahead. These are based on current and anticipated workloads and make various assumptions on the retention of staff beyond the former retirement age of 60.

In addition, each of ONR's divisions has identified current and anticipated staff requirements in terms of technical discipline. As well as identifying current vacancies, this work has identified potential pressure points caused by future retirements, and where there is a vulnerability arising from only having a single expert in a particular discipline.

Inspectors' Qualifications

All inspectors joining ONR have good academic qualifications and several years of experience in a relevant industry such that they can be regarded as being technical experts in their own discipline.

The purpose of the training is to expand and build on this base rather than “convert” them to acquire another knowledge base. It can be regarded as a “holistic” approach to training. To achieve this, the initial training is in two main areas:

- Training to be a regulator – as few new recruits have prior knowledge of regulation; and
- Training to expand recruits' technical expertise to gain a working knowledge of other essential technical disciplines.

Competence framework

In 2008 a new competence framework was developed for nuclear safety inspectors. This framework was based on the requirements of “National Occupational Standards for Nuclear Regulators”⁷. This is a high level standard and it sets out the basic requirements for all regulators involved in nuclear safety and security including the environment agencies and transport.

The competence framework was initially trialled and is being refined continuously to reflect feedback. The purpose of the framework is to specify the training need for specific job functions as well as identifying the basic training needs.

Continued professional development

Whilst considerable effort is spent on the training of new recruits, ONR also has a refresher training programme to develop professional competencies for all staff. ONR's policy is that this is not centrally managed but is a matter for individual inspectors to agree with their line managers with advice from senior experts in their technical field. Such training covers topics such as communication, influencing skills, change management and interpersonal skills, as well as the development of technical competencies.

1.2.2.2 Environment Agency

Organisation

The Environment Agency (EA) has a board of up to 15 members, including the Chairman and Chief Executive, who are accountable to Government Ministers, and to the Welsh Ministers for its operations in Wales, for the Environment Agency's organisation and performance. All are appointed by the Secretary of State for Environment, Food and Rural Affairs, except for one Board Member for Wales, who is appointed by the WG. The Board delegates the Environment Agency's day-to-day management to its Chief Executive and staff.

For most of its activities, the Environment Agency has broken down its work between 7 geographical regions. In each region, three statutory committees advise the Environment Agency about the operational performance of its functions, regional issues of concerns and regional implications of national policy proposals. These committees are the Regional Fisheries, Ecology and Recreation Advisory Committee, Regional Flood Defence Committee and the Regional Environment Protection Advisory Committee. There is also an advisory committee for Wales.

Committee members are appointed under statutory membership schemes designed to achieve representation from a wide range of the Environment Agency's stakeholders. All Regional Environment Protection Advisory Committee meetings are advertised locally and the public is welcome to attend.

⁷ National Occupational Standards for Nuclear Regulators
http://www.ukstandards.org.uk/Find_Occupational_Standards.aspx?NosFindID=4&FormMode=ViewModeSuite&SuiteID=2015

The Environment Agency has established two specialist groups (North and South) to carry out the regulation of radioactive waste disposals from the nuclear industry. These groups regulate discharges of liquid and gaseous wastes on and off nuclear licensed sites and disposal of solid radioactive waste. Associated with the northern group are two assessment teams providing national support on solid waste disposal and on generic designs of potential new nuclear reactors. Similarly, associated with the southern group, there is a small team providing national support on radiation incident management.

The Radioactive Substances Regulation Group, working within the Environment Agency's national office, leads on regulatory process development and implementation including developing regulatory guidance. There is also a national group responsible for checking, monitoring and assessment of discharges to the environment.

The Environment Agency and the Food Standards Agency liaise closely to ensure that their environmental monitoring programmes in England and Wales are appropriate. Annual results from the environmental monitoring programme in the UK are published jointly by the environment agencies and the Food Standards Agency in the annual RIFE report⁸. The latest results published are from the 2009 environmental monitoring programme.

Financial resources

The Environment Agency has a total budget of almost £1.0 billion, over half of which is spent on flood defence and, in 2010/2011; £252.9 million was spent on Environment Protection. Income is derived chiefly from three sources:

- (a) Income raised from charging for regulation;
- (b) Flood defence levies;
- (c) Government grants, which help to finance amongst other things, pollution prevention and control activities.

EA95 provides the Environment Agency with the power to impose financial charges for regulators activities in order to recover the expenses incurred through regulation. Such expenses include those incurred in respect of a programme of waste and environmental monitoring carried out by Environment Agency. The Environment Agency uses a work recording system to identify the effort and expenses of its staff attributable to each licensee.

The Environment Agency charges operators for its nuclear regulatory activities on the basis of a daily rate for inspectors. This rate is reviewed annually. The Environment Agency also recharges operators for the monitoring it carries out. Annual charges for nuclear and non-nuclear regulatory work and monitoring activities in financial year 2009/2010 were approximately £12.8 million.

Human resources

The Environment Agency has a total of over 12,000 staff, although only a small proportion of these are involved in nuclear regulation. The North and South nuclear regulatory groups have a total of around 45 technical staff, with additional administrative support. The other groups identified above involved with nuclear regulatory activities comprise approximately a further 19 technical staff.

Inspectors' qualifications

Nuclear regulatory staff recruited by the Environment Agency are required to have a good honours degree in science or engineering, and several years experience in a technical or management role in the nuclear industry.

1.2.2.3 Scottish Environment Protection Agency

⁸ Radiation in Food and the Environment, 2009, RIFE 152, Food Standards Agency, <http://www.food.gov.uk/science/surveillance/radiosurv/rife/rife2009/>

Organisation

Members of SEPA's Main Board are appointed by the Scottish Ministers, and comprise a Chairman, a Deputy Chairman and between eight and ten members, including the Chief Executive. Legally, the Agency Board constitutes SEPA. The members of the Board are appointed by the Scottish Ministers and, as well as appointing the Chairman of SEPA, the Scottish Ministers appoint a member as Deputy Chairman. The Chairman is personally responsible to Scottish Ministers. The Board has responsibility for ensuring that SEPA fulfils the aims and objectives set by the Scottish Ministers and membership of the Board includes a Chief Executive to whom is delegated the day-to-day management of SEPA.

The Board has ultimate responsibility for the organisation. It meets regularly and is specifically concerned with:

- Establishing the overall strategic direction of SEPA within the policy and resources framework agreed with the responsible Minister;
- Overseeing the delivery of planned results by monitoring performance against agreed objectives and targets;
- Demonstrating high standards of corporate governance at all times; and
- Ensuring that statutory requirements for the use of public funds are complied with.

SEPA has one specialist team that deals with radioactive waste disposals from nuclear sites in Scotland. The Radioactive Substances Unit (RS Unit) covers the day-to-day regulatory activities such as issuing authorisations, inspection, enforcement etc. and also covers more strategic matters such as liaison with Government or other bodies and in influencing the development of forthcoming policy or legislation. This Unit is also responsible for managing part of RIMNET in Scotland, and leads on environmental monitoring such as the collection and assessment of samples. In all, there are around 40 technical staff dealing with radioactive substances, the majority of whom have some involvement in matters relating to nuclear sites.

SEPA manages a monitoring programme that assesses levels of man-made radioactivity in the environment using a number of environmental indicators. The samples of water, food, soil etc, collected as part of SEPA's programme, act both as indicators of the state of the environment and to verify that the levels of radioactivity present within these commodities have low radiological significance to man.

Results from the environmental monitoring programme are used as the basis for dose calculations to members of the public from consumption of food and exposures of members of the public from waste disposals.

In Scotland, the Food Standards Agency and SEPA liaise closely together to ensure that the environmental monitoring programme for radioactivity is appropriate. Annual results from the environmental monitoring programme in the UK are published jointly by the environment agencies, the Food Standards Agency and NIEA in a report entitled 'Radioactivity in Food and the Environment'. The latest results published are from the 2009 environmental monitoring programme⁹.

SEPA also has three Regional Boards, reflecting its regional structure, each chaired by a member of the main Board. A Regional Board's general responsibilities include advising on the development of the business plans for the region, the generation and implementation of local initiatives for the environment, and advising on applications that have major effects on the local area.

SEPA has two specialist teams dealing with the radioactive waste disposals from nuclear sites in Scotland. The Environmental Protection and Improvement Unit covers the day-to-day regulatory activities such as issuing authorisations, inspection, enforcement etc. The Policy Unit covers more strategic matters

⁹ See footnote 4 above.

such as liaison with Government or other bodies, influencing the development of forthcoming policy or legislation. This Unit also leads on environmental monitoring such as the collection and assessment of samples.

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Financial resources

SEPA's income is derived chiefly from three sources:

- Income raised from charging for regulation.
- Government grant-in-aid, which helps to finance work that is not cost-recoverable through charging schemes.
- Other sources (like financial agreements with NDA).

In the financial year 2009/10, SEPA's total income was £83.75m of which £48.3m was grant-in-aid from the Scottish Government. SEPA charges operators for its nuclear regulatory activities on the basis of a daily rate for an inspector, which includes an appropriate overhead allowance. The prices for all SEPA charging schemes can be updated annually by up to the Retail Price Index. In the event that SEPA prices have to increase by more than the Retail Price Index, or a scheme requires other changes, a public consultation is held. All changes which have been the subject of consultation have to be approved by the Scottish Ministers before SEPA can implement them. SEPA's income from all charging schemes totalled £33.2m in 2009/10.

Human resources

SEPA has approximately 1300 staff, with around 30 technical staff dealing with radioactive substances, the majority of whom have some involvement in matters relating to nuclear sites.

SEPA has approximately 1000 staff, around 40 of whom are involved directly in nuclear site regulation, either under RSA93 or other environmental regulatory regimes that apply on nuclear licensed sites governing the management of controlled and hazardous wastes.

Inspectors' qualifications

Nuclear regulatory staff recruited by the Agency are required to have a degree in a relevant discipline.

1.2.2.4 Northern Ireland Environment Agency

Organisation

NIEA is headed by a Chief Executive, with a Board of Directors, which spans the four Directorates - Natural Heritage, Built Heritage, Environmental Protection and Corporate Services together with two independent members. The board ensures the Agency carries out its statutory functions and activities, which are governed by primary legislation and regulations.

The Industrial Pollution and Radiochemical Inspectorate (IPRI) is responsible for controlling the keeping and use of radioactive material and the disposal of radioactive waste under the Radioactive Substances Act 1993. IPRI also enforces the statutory control of the transport of radioactive material. The Environmental Policy Division is involved in the development of strategic issues, policy and legislation.

NIEA operate a comprehensive monitoring programme of seaweed, sediment, fish, nephros and winkle samples from various sites around the coastline as well as monitoring the gamma dose rate in air over intertidal sediments in each district council area which has a coastline. The results of this monitoring are published in the 'Radioactivity in Food and the Environment' (RIFE) report.

Financial resources

The primary source of income for NIEA comes from Central Government. In the financial year 2010-2011, the Agency's budget allocation was £44.4 million. NIEA charges operators for its regulatory activities with the charges being based on anticipated regulatory effort associated with the processing and monitoring of environmental permits.

Human resources

NIEA has a total of over 750 staff with a small number involved in the regulation of radioactive substances.

Inspectors' qualifications

Radioactive substances regulatory staff recruited by NIEA are required to have a degree in an appropriate discipline plus relevant experience.

1.3 National implementing organisations

1.3.1 Scope of responsibility

1.3.1.1 Nuclear Decommissioning Authority

Much of the UK civil nuclear sector (in particular, electricity production, associated fuel cycle plants and research facilities) is undergoing significant changes; many facilities are nearing the end of their operating lives, and there is greater emphasis on decommissioning, site clean-up and restoration. The UK Government has established the Nuclear Decommissioning Authority (NDA), which became operational on 1 April 2005. The NDA is responsible for the civil public sector nuclear facilities in the UK (see section 4) and has also been given responsibility for the implementation of geological disposal within the UK (see section 1.3) and for the development of a national strategy for solid LLW from the nuclear industry (see section 3.3).

In June 2008 the UK Government and devolved administrations for Wales and Northern Ireland published the Managing Radioactive Waste Safely (MRWS) White Paper setting out a framework for implementing geological disposal for higher activity wastes. The White Paper explains that the NDA is the implementing organisation, responsible for planning and delivering the geological disposal facility and, as part of this process, will engage with communities and other stakeholders. The NDA already provides interim storage of waste on its sites and will continue to do so for as long as it takes to site and construct a

geological disposal facility. The NDA also undertakes a programme of research and development to support optimised delivery of geological disposal and interim storage.

The 2008 MRWS White Paper intentionally does not set out a timescale for the MRWS site assessment and selection process, recognising that the voluntarism approach should proceed at a rate with which communities are comfortable. However, the White Paper does set out the stages that are expected to take place in the site selection process.

In the 2008 White Paper the Welsh Government reserved its position on the policy of geological disposal.

The Scottish Government published its policy on higher-activity radioactive waste in January 2011 that the long-term management of higher-activity waste (HAW) should be in near-surface facilities. Facilities should be located as near as possible to the site where the waste is produced, and developers will need to demonstrate how the facilities will be monitored and how waste packages, or waste, could be retrieved. All long-term waste management options will be subject to robust regulatory requirements.

1.3.2 Organisation and resources

1.3.2.1 Nuclear Decommissioning Authority

The NDA takes an integrated view across the waste management chain, with both long and short term issues addressed in planning and strategy development. In 2007 the NDA established the Radioactive Waste Management Directorate (RWMD), incorporating resources from the former United Kingdom Nirex Ltd, which will develop into an effective delivery organisation to implement geological disposal.

The RWMD became a prospective Site Licence Company for delivering geological disposal in December 2009. The plan is to form a wholly owned subsidiary of the NDA that will hold disposal authorisations under the Radioactive Substances Act and a site licence under the Nuclear Installations Act. The skills and expertise required are driven by the requirements of a Safety and Environment Management Prospectus being developed in co-operation with regulators.

Implementation of the geological disposal facility programme by the NDA will comply fully with relevant UK and international legislation and conventions. Regulatory bodies will work closely together to ensure the regime as a whole is coherent, effective and efficient. Individual aspects of regulation will be carried out in accordance with the statutory responsibilities of each regulatory body and will be clearly delineated. It will be the responsibility of the RWMD to ensure that its programme is appropriately coordinated as part of a staged application and approval process to ensure that permissions are obtained in the right order.

Financial resources

The RWMD has a budget of around £24 million for the 2011/12 financial year. However, this is likely to be increased as progress is made in finding a prospective repository location.

The cost of a geological disposal facility will be influenced by many different factors, including the inventory of waste, the geology at the site in question and the design of the geological disposal facility. The NDA has developed a parametric cost model which allows the implications and costs of different scenarios to be assessed. The current best estimate for a geological disposal facility is about £12 billion (at 2008 money values).

Human resources

RWMD's staffing strategy is based on the premise of a lean intelligent client organisation of highly skilled and suitably qualified and experienced individuals, supplemented by expert contract support from the supply chain.

At the start of 2011, RWMD has approximately 73 staff members. A review of the organisational structure was undertaken with the aim of delivering the programme mission and objectives in the most efficient manner. The restructure followed a review by the RWMD executive of the mission and objectives as well as considering the original expectations set out in the MRWS White Paper and the directorate's role in new nuclear build, upstream optioneering (innovation) and EC-funded and other international cooperation work.

A proposed organisational structure was developed, followed by a period of collective consultation with staff, including trade union representatives. The proposed structure was discussed with the Environment Agency, office for Nuclear Regulation and Department of Transport who had no objections to proceeding with its implementation.

The new structure came into effect on June 1st 2011. and has 90 posts. RWMD is currently recruiting additional staff to fill the outstanding vacancies.

2. LEGAL FRAMEWORK

2.1 Primary Legislation and General Regulations

2.1.1 Nuclear Installations Act 1965

Under the Nuclear Installations Act 1965, (NIA65)¹⁰ no site can be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence is currently in force, granted by the HSE and since 1 April 2011, ONR. Only a corporate body, such as a registered company or a public body, can hold a licence and the licence is not transferable. Sections 1, 3 to 6, 22 and 24A of the NIA65 are relevant statutory provisions of the HSWA74 (i.e. these sections are subject to HSWA74 arrangements for regulation and enforcement). The Act empowers ONR to attach conditions in the interests of safety or radioactive waste management to any licence that it grants.

2.1.2 Nuclear Installations Regulations 1971

The Nuclear Installations Regulations 1971¹¹ prescribe, among other things, those spent fuel and radioactive waste management installations for which a nuclear site licence is required. These are installations designed or adapted for:

- “the processing of irradiated nuclear fuel other than processing carried out solely for the purpose of chemical or isotopic assay or metallographic investigation of such nuclear fuel”; and
- the “storage of irradiated nuclear fuel, [or] bulk quantities of any other radioactive matter which has been produced or irradiated in the course of the production or use of nuclear fuel, other than storage incidental to carriage and in the case of irradiated nuclear fuel other than storage incidental to” the purposes of chemical or isotopic assay or metallographic investigation of such nuclear fuel.

¹⁰ Nuclear Installations Act 1965 (as amended) (1965 c.57), <http://www.statutelaw.gov.uk/Home.aspx>

¹¹ Nuclear Installations Regulations 1971, ISBN 0-11-010381-5

2.1.3 Health and Safety at Work etc. Act 1974

The Health and Safety at Work etc. Act 1974 (HSWA74)¹² places general duties on all employers (not just nuclear site licensees) to conduct their undertakings in such a way as to ensure, so far as is reasonably practicable, the health and safety at work of their employees and also of persons not in their employment who may be affected by their work activities.

2.1.4 Ionising Radiations Regulations 1999

The Ionising Radiations Regulations 1999 (IRR99)¹³ provide for the protection of all workers and members of the public, whether on licensed sites or elsewhere, from ionising radiations. IRR99 implement aspects of the BSS Directive¹⁴ which established basic safety standards, including the setting of radiation dose limits for employees and members of the public for all activities involving ionising radiation. IRR99 also implement Council Directive 90/641/Euratom¹⁵ on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas. Outside workers are persons undertaking activities in radiation controlled areas designated by an employer other than their own.

2.1.5 Justification of Practices Involving Ionising Radiation Regulations 2004

In August 2004, the Justification of Practices Involving Ionising Radiation Regulations 2004¹⁶ came into force. These regulations provide for the justification of new classes or types of practice and the review of existing classes or types of practice where there is new and important evidence regarding their consequences or effectiveness.

2.1.6 Environment Act 1995

The Environment Act 1995 (EA95)¹⁷ sets the basis for the regulatory framework with respect to environmental protection. It also established the Environment Agency and the Scottish Environment Protection Agency (SEPA) as regulators together with their funding arrangements.

¹² Health and Safety at Work etc. Act 1974 (1974 c.37), <http://www.hse.gov.uk/legislation/hswa.pdf>

¹³ The Ionising Radiations Regulations 1999, <http://www.opsi.gov.uk/si/si1999/19993232.htm>

¹⁴ 96/29/Euratom - Basic Safety Standards for radiation protection, 1996, Official Journal of the European Communities (1996) 39, No. L159, http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf

¹⁵ 90/641/Euratom – Outside Workers Directive, http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/90641_en.pdf

¹⁶ Justification of Practices Involving Ionising Radiation Regulations 2004, <http://opsi.gov.uk/si/si2004/20041769.htm>

¹⁷ Environment Act 1995 (c25) http://www.opsi.gov.uk/acts/acts1995/ukpga_19950025_en_1

2.1.7 Environmental Permitting (England and Wales) Regulations and Radioactive Substances Act 1993

The Environmental Permitting (England and Wales) Regulations 2010 (EPR10)¹⁸ and in Scotland and Northern Ireland, the Radioactive Substances Act 1993 (RSA93)¹⁹ require prior authorisation to dispose of radioactive waste, including that from nuclear installations. ERP10 and RSA93 also require prior authorisation for the keeping and use of radioactive material (other than by nuclear sites licensees) and prior authorisation for the accumulation of radioactive waste (other than on nuclear licensed sites). EPR10 and RSA93 empower the appropriate environment agency to attach limits and conditions to any environmental permit or authorisation that it issues. The Energy Act 2004 amended RSA93 to allow the transfer of authorisations from one person to another following consultation with statutory consultees. This avoids the need for a new application to be made for authorisation under the RSA93, and also harmonises radioactive substances regulation with other areas of environmental regulation. Similar powers to enable transfer of environmental permits are provided under EPR10.

The EPR10 introduced a new power in England and Wales for staged regulation of the development of underground disposal facilities for radioactive wastes. An environmental permit will be required before the start of intrusive site investigation, such as borehole drilling, at a candidate site for an underground disposal facility.

Legal requirements for the keeping and use of radioactive material and authorisation for the accumulation of radioactive waste on a nuclear licensed site are addressed by provisions in the Licence Conditions attached to each nuclear site licence, which are enforced by ONR.

A review of Exemption Orders under RSA93 (including the Substances of Low Activity Exemption Order) has been undertaken with the aim of simplifying regulation for those seeking or using an Exemption Order, whilst at the same time maintaining appropriate protection to human health and the environment. New Regulations implementing the updated exemptions regime came into force across the UK in October 2011²⁰²¹²².

2.1.8 Radiation (Emergency Preparedness and Public Information) Regulations 2001

The Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR)²³ implemented in Great Britain the Articles on intervention in cases of radiation emergency in the BSS Directive. They also partly implement Council Directive 89/618/Euratom²⁴ on informing the general public about health protection measures to be applied and steps to be taken in the event of an emergency. A radiation emergency is defined as a reasonably foreseeable event that is likely to result in any member of the public receiving an effective dose of 5mSv during the year immediately following the emergency.

¹⁸ Environmental Permitting (England and Wales) Regulations 2010 (EPR10), April 2010.
<http://www.defra.gov.uk/environment/policy/permits/guidance.htm>

¹⁹ Radioactive Substances Act 1993 http://www.opsi.gov.uk/ACTS/acts1993/Ukpga_19930012_en_1.htm

²⁰ The Environmental Permitting (England and Wales) (Amendment) Regulations 2011.
<http://www.legislation.gov.uk/ukdsi/2011/9780111512319/contents>

²¹ The Radioactive Substances Exemption (Scotland) Order 2011,
<http://www.legislation.gov.uk/ssi/2011/147/contents/made>

²² The Radioactive Substances Exemption (Northern Ireland) Order 2011,
<http://www.legislation.gov.uk/nisr/2011/289/contents/made>

²³ Radiation (Emergency Preparedness and Public Information) Regulations 2001, SI 2975,
<http://www.opsi.gov.uk/sr/sr2001/20010436.htm>

²⁴ 89/618/Euratom, Official Journal of the European Communities (1989) 32, No L357,
http://www.bnsa.bas.bg/eurolex/31989L0618_en.pdf

2.1.9 High Activity Sealed Sources and Orphan Sources Regulations 2005

The High Activity Sealed Sources and Orphan Sources Regulations 2005 (HASS Regulations)²⁵ implement European Council Directive 2003/122/Euratom. They established a regulatory system for the authorisation of practices involving high-activity sealed sources. Under the Regulations, before issuing such an authorisation, the relevant competent authority must ensure that adequate arrangements exist for the safe management of sources, including when they become disused sources. These latter arrangements may provide for the transfer of disused sources to the supplier or to a recognised storage facility. In addition, financial provision must have been made to cover the cost of managing disused sources safely, including in the eventuality of the holder becoming insolvent or going out of business.

The HASS Regulations have been incorporated into the Environmental Permitting (England and Wales) Regulations 2010²⁶. This did not involve any change in the scope or nature of the regulatory regime. The HASS Regulations continue to apply in Scotland and Northern Ireland.

2.1.10 Management of Health and Safety at Work Regulations 1999

The Management of Health and Safety at Work Regulations 1999 (MHSW99)²⁷ include requirements on employers, including nuclear site licensees, to:

- make assessments of the health and safety risks of their activities;
- make, give effect to and record the appropriate health and safety arrangements;
- ensure that their employees are provided with appropriate health surveillance;
- appoint an adequate number of competent persons to assist them in complying with health and safety legislation;
- establish and give effect to procedures to be followed in the event of serious or imminent danger arising;
- provide employees with information concerning the:-
 - risks to their health and safety;
 - preventive and protective measures;
 - procedures necessary in the event of serious or imminent danger; and
 - persons nominated to implement evacuation procedures;
- co-operate with other employers to enable statutory health and safety obligations to be met, including the provision of health and safety information; and
- ensure that employees, taking into account their capabilities, have adequate health and safety training which is repeated periodically as appropriate.

2.1.11 Energy Act 2004

The Energy Act 2004 established a new cross-border Non-Departmental Public Body, the Nuclear Decommissioning Authority (NDA), which came in to being in April 2005 to take over the responsibility

²⁵ The High-activity Sealed Radioactive Sources and Orphan Sources Regulations 2005 , SI 2686, <http://www.opsi.gov.uk/si/si2005/20052686.htm>

²⁶ Schedule 23, part 4, Environmental Permitting (England and Wales) Regulations 2010 (EPR10), April 2010, <http://www.defra.gov.uk/environment/policy/permits/guidance.htm>

²⁷ The Management of Health and Safety at Work Regulations 1999, SI 3242, <http://www.opsi.gov.uk/SI/si1999/19993242.htm>

for decommissioning, and operation via civil contracts with operators pending decommissioning, of designated civil nuclear sites.

2.1.12 Health and Safety (Fees) Regulations

The annual Health and Safety (Fees) Regulations (the latest being for 2009)²⁸ provide for the charging of fees for work by ONR in relation to the assessment of a design proposal for any new nuclear installation. This includes any matters relating to the installation's construction, commissioning, operation and decommissioning, which are to be assessed by ONR prior to any application for a nuclear site licence under NIA65] that may be made based upon the particular design proposal that has been assessed.

2.1.13 Environmental Protection Act 1990

Part IIA of the Environmental Protection Act 1990 (EPA90)²⁹ set up a system for the regulation of contaminated land in England, Wales and Scotland. The regime provides a framework for identifying and remediation of contaminated land. Part IIA defines contaminated land as land that poses unacceptable risks through its current use.

In 2006 in England and Wales, and 2007 in Scotland, the Part IIA regime was extended to apply to land contaminated with radioactivity resulting from uses of radioactive materials. It only applies in circumstances where the radioactivity is the result of a past practice or work activity, or the after-effects of a radiological emergency. This includes substances containing artificial radionuclides or processed natural radionuclides. Radioactivity originating from nuclear sites was excluded from these regulations. However, the liability for any harm that such radioactivity might cause was already covered by the NIA65.

2.1.14 Radioactive Contaminated Land Regulations

The Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2007³⁰ modified EPA90 in England so that it applies to radioactivity originating from nuclear sites. Similar modifications apply in Wales. Parallel regulations apply in Northern Ireland. Modifications which apply in Scotland are The Radioactive Contaminated Land (Scotland) Regulations 2007 (SSI 2007/179), The Radioactive Contaminated Land (Scotland) (Amendment) Regulations 2007 (S.I No. 2007/3240) and The Radioactive Contaminated Land (Scotland) Amendment Regulations 2009 (SSI 2009/202) and the Radioactive Contaminated Land (Scotland) Amendment Regulations 2010 (SSI 2010/2153)³¹.

²⁸ The Health and Safety (Fees) Regulations 2008, http://www.opsi.gov.uk/si/si2008/uksi_20080736_en_1

²⁹ Environmental Protection Act 1990 (c. 43) http://www.opsi.gov.uk/acts/acts1990/Ukpga_19900043_en_1.htm

³⁰ Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2007, SI 3245, http://www.opsi.gov.uk/si/si2007/uksi_20073245_en_1

³¹ The Radioactive Contaminated Land (Scotland) Regulations 2007 (SSI 2007/179), http://www.opsi.gov.uk/legislation/scotland/ssi2007/pdf/ssi_20070179_en.pdf, The Radioactive Contaminated Land (Scotland) (Amendment) Regulations 2007 (S.I No. 2007/3240), http://www.opsi.gov.uk/si/si2007/uksi_20073240_en_1,

The Radioactive Contaminated Land (Scotland) Amendment Regulations 2009, http://www.opsi.gov.uk/legislation/scotland/ssi2009/pdf/ssi_20090202_en.pdf

The Radioactive Contaminated Land (Scotland) Amendment Regulations 2010, http://www.opsi.gov.uk/legislation/scotland/uksi2010/pdf/ssi_20090202_en.pdf

2.1.15 Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations

The Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR99)³² implement the requirement for an environmental impact assessment for decommissioning nuclear power stations and nuclear reactors arising from Council Directive 85/337/EEC³³ (as amended by Council Directive 97/11/EC³⁴ on the assessment of the effects of certain public and private projects on the environment. Before decommissioning or dismantling of a nuclear reactor or power station can take place, a licensee must apply to ONR for consent, undertake an environmental impact assessment and provide an environmental statement. The information to be included in an environmental statement is referred to and specified in Schedule 1 to the Regulations. A list of HSE determinations is given in the Fourth UK Report to the Convention on Nuclear Safety³⁵. In future, such determinations will be undertaken by ONR.

2.1.16 Other relevant legislative frameworks

Planning / Environmental Assessment Regulation

The planning regulatory framework covers, in general, requirements for Environmental Impact Assessments (EIA).

To streamline the planning process for major infrastructure projects in England and Wales, the need for fundamental reform of the planning system was identified by the Government, and the process was commenced with the introduction of the Planning Act 2008¹⁹¹, which provides for a more efficient, transparent and accessible planning system. This new planning process applies to major infrastructure projects such as development of new nuclear power plants. The planning process is entirely separate from the nuclear licensing process.

In most cases including major infrastructure projects in Scotland and Northern Ireland, local planning authorities are the competent authorities.

The planning application process provides an opportunity to inform and obtain views from the public. For major developments such as a radioactive waste repository, this could be through the public inquiry process. Similarly, the environment agencies will consult on a developer's application for the authorisation of disposal of radioactive waste in a repository. HSE including ONR, the Environment Agency and SEPA have corporate policies to ensure that public information is available in an open and transparent manner, subject to the requirements of the Freedom of Information Act 2002³⁶, the Freedom of Information (Scotland) Act 2002³⁷, and the Environmental Information Regulations 2004, and the Environmental Information (Scotland) Regulations 2004³⁸.

One of the statutory objectives of the environment agencies is to develop a close and responsive relationship with the public, local authorities and other representatives of local communities and regulated organisations. In determining applications for radioactive waste disposals on or from sites licensed under NIA65, the agencies consult statutory bodies such as local and health authorities, fisheries and agriculture

³² Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999, SI 2892, <http://www.opsi.gov.uk/si/si1999/19992892.htm>

³³ European Directive 85/337/EEC, <http://ec.europa.eu/environment/eia/full-legal-text/85337.htm>

³⁴ European Directive 97/11/EC, <http://ec.europa.eu/environment/eia/full-legal-text/9711.htm>

³⁵ Fourth UK Report to the Convention on Nuclear Safety, <http://www.hse.gov.uk/nuclear/legal.htm>

³⁶ Freedom of Information Act 2000, <http://www.opsi.gov.uk/acts/acts2000/20000036.htm>

³⁷ Freedom of Information (Scotland) Act 2002, <http://www.opsi.gov.uk/legislation/scotland/acts2002/20020013.htm>

³⁸ Environmental Information (Scotland) Regulations 2004, <http://www.opsi.gov.uk/legislation/scotland/ssi2004/20040520.htm>

committees, in addition to the Food Standards Agency and ONR. They also undertake wide public consultation. After considering all the views expressed, they publish a “decision document” setting out their decision and the reasons behind it, including their response to issues raised during consultation. In Scotland, SEPA also consults with the Scottish Government for applications made to dispose of radioactive waste from nuclear licensed sites under the terms of a mutual agreement to enable decisions to be taken as to whether Ministers wish to exercise their powers under the RSA93.

2.1.17 Transport of radioactive materials

The UK’s regulatory framework for the transport of radioactive material reflects international codes, treaties and regulations:

- the GB Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2007³⁹;
- the Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997⁴⁰;
- Merchant Shipping Notice No MSN 1791(M), the Carriage of Dangerous Goods and Marine Pollutants in Packaged Form – Amendment 32-04 to the IMDG Code⁴¹; and
- the Air Navigation Order 2005⁴², together with the Air Navigation (Dangerous Goods) Regulations 2002⁴³, amended in 2004, SI 2004⁴⁴.

2.1.18 Transfrontier shipments

The regulatory framework for transfrontier shipment of radioactive materials and radioactive waste derive from European requirements that are either directly applicable European legislation or are implemented in the UK through the European Communities Act 1972⁴⁵.

In 2006, the EC published a Council Directive on the supervision and control of shipments of radioactive waste and spent fuel (Council Directive 2006/117/Euratom (“the Shipments Directive”)⁴⁶. This Directive is transposed into UK law by the Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008 which entered into force in December 2008.

The Regulations apply across the UK and extend the scope of regulation to cover shipments of spent nuclear fuel that are sent for reprocessing (the recovery of reusable uranium and plutonium), in addition to shipments of radioactive waste. The Regulations are administered in the UK by the Environment Agency in England and Wales, SEPA in Scotland, and the Northern Ireland Environment Agency (NIEA) in Northern Ireland.

³⁹ The GB Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2007, SI 1573 http://www.opsi.gov.uk/si/si2007/uksi_20071573_en_1

⁴⁰ The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997, SI 2367 <http://www.opsi.gov.uk/si/si1997/19972367.htm>

⁴¹ Merchant Shipping Notice No MSN 1791(M), The Carriage of Dangerous Goods and Marine Pollutants in Packaged Form – Amendment 32-04 to the IMDG Code

⁴² The Air Navigation Order 2005, SI 1970, <http://www.opsi.gov.uk/si/si2005/20051970.htm>

⁴³ The Air Navigation (Dangerous Goods) Regulations 2002, SI 2786, <http://www.opsi.gov.uk/si/si2002/20022786.htm>

⁴⁴ The Air Navigation (Dangerous Goods) Regulations 2002 Amendment 2004, SI 3214, <http://www.opsi.gov.uk/si/si2004/20043214.htm>

⁴⁵ European Communities Act 1972, (c68) (as amended in 1993), http://www.opsi.gov.uk/RevisedStatutes/Acts/ukpga/1972/cukpga_19720068_en_1

⁴⁶ Council Directive 2006/117/EURATOM, November 2006, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:337:0021:0032:EN:PDF>

2.1.19 Northern Ireland

There are no nuclear installations in Northern Ireland, which has its own regulatory framework that mirrors that in the rest of the UK. In addition to RSA93, the relevant statutory provisions for the province include:

- the Health and Safety at Work (Northern Ireland) Order 1978⁴⁷;
- the Ionising Radiation Regulations (Northern Ireland) 2000⁴⁸;
- the Radiation (Emergency Preparedness and Public Information Regulation) (Northern Ireland) 2001⁴⁹;
- Radioactive Contaminated Land Regulations (Northern Ireland) 2006⁵⁰;
- Radioactive Contaminated Land Regulations (Northern Ireland) (Amendment) Regulations 2010⁵¹; and the
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (Northern Ireland) 2010⁵²

Additionally, the Department of the Environment, Northern Ireland (DOENI) has made legislation (The Radioactive Substances (Basic Safety Standards) Regulations (Northern Ireland) 2003)⁵³, under powers conferred by the European Communities Act 1972, to meet the obligations imposed by the BSS Directive. The Department has made The Radioactive Substances Exemption (Northern Ireland) Order 2011⁵⁴ and The Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011⁵⁵

2.2 Regulations concerning specific activities or facilities

2.2.1 *Radioactive waste management*

2.2.2 *Decommissioning*

In the UK regulations are not granted to specific facilities or activities. Instead a range of permits are issued under the national legislation described above.

⁴⁷ The Health and Safety at Work (Northern Ireland) Order 1978
http://www.opsi.gov.uk/RevisedStatutes/Acts/nisi/1978/cnisi_19781039_en_1

⁴⁸ The Ionising Radiation Regulations (Northern Ireland) 2000, SR 375,
<http://www.opsi.gov.uk/sr/sr2000/20000375.htm>

⁴⁹ The Radiation (Emergency Preparedness and Public Information Regulation) (Northern Ireland) 2001, SR 436,
<http://www.opsi.gov.uk/sr/sr2001/20010436.htm>

⁵⁰ Radioactive Contaminated Land Regulations (Northern Ireland) 2006, SR 345,
<http://www.opsi.gov.uk/Sr/sr2006/20060345.htm>

⁵¹ Radioactive Contaminated Land Regulations (Northern Ireland) (Amendment) Regulations 2010 SR 2145
<http://www.legislation.gov.uk/ukxi/2010/2145/contents/made>

⁵² The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (Northern Ireland) 2010, SR 160 <http://www.legislation.gov.uk/nisr/2010/160/contents/made>

⁵³ The Radioactive Substances (Basic Safety Standards) Regulations (Northern Ireland) 2003, SR 208,
www.opsi.gov.uk/si/si2005/ukxi_20052686_en.pdf

⁵⁴ The Radioactive Substances Exemption (Northern Ireland) Order 2011, SR 289
<http://www.legislation.gov.uk/nisr/2011/289/contents/made>

⁵⁵ The Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011, SR 290
<http://www.legislation.gov.uk/nisr/2011/290/contents/made>

2.3. Guidance on implementation

2.3.1 Radioactive waste management

2.3.1.1 Office for Nuclear Regulation - principles, regulations and guides

Guidance for nuclear licensed sites

The regulatory approach to nuclear safety (**including radioactive waste management**) in the UK is based on a nuclear site licensing regime. Hence, most of the requirements for nuclear safety are imposed by means of Conditions attached to the nuclear site licence. As a result, ONR does not specifically set out its requirements for nuclear safety in the form of regulations. However, some issues arising from European Council and Euratom Directives have been addressed by the implementing UK regulations.

Conditions of the nuclear site licence of particular reference to radioactive waste management are listed below. ONR exercises the powers under these conditions:

- LC14 requires the licensee to set up arrangements for the preparation and assessment of the safety related documentation comprising 'safety cases' to ensure that the licensee justifies safety during design, construction, manufacture, commissioning, operation and decommissioning.
- LC19 enables ONR to control the design and construction of any facility used for the management of spent fuel or radioactive waste. Consent to the construction of any new facility will only be given when ONR is satisfied with the licensee's safety case that must address all nuclear safety issues, including criticality, shielding, containment and the ability of the plant to remove decay heat under normal and fault conditions.
- LC20 allows ONR to control design changes that could impact on the plant safety case.
- LC21 requires the licensee to produce arrangements to safely commission new facilities: ONR uses its powers to ensure that there are sufficient safety systems in place. The licensee cannot take a new plant into operation without the consent of ONR and this will only be given when ONR is satisfied with the pre-operational safety case.
- LC22 is used to control modifications to any operating spent fuel or radioactive waste management facility and again the licensee cannot carry out a modification which could have a significant affect on safety without the agreement of ONR.
- LC23 requires that the spent fuel or radioactive waste management facility has an adequate safety case and that it identifies the conditions and limits that ensure that the plant is kept in a safe operating envelope.
- LC24 ensures that all operations that may affect safety, including any instructions to implement Operating Rules, are undertaken in accordance with written operating instructions.
- LC32 Minimising the generation of radioactive waste
The licensee of a spent fuel management facility is required under Licence Condition 32 (Accumulation of Radioactive Waste) to ensure that the rate of production and total quantity of radioactive waste accumulated on the site is minimised and adequate records are made.

The Safety Assessment Principles (SAPs)⁵⁶ form a framework used by its inspectors as a reference for technical judgments on the adequacy of licensees' safety cases. The SAPs will continue to be used by ONR to assist it in applying a consistent and uniform approach to its assessment process. In carrying out an assessment, ONR's nuclear inspectors judge the extent to which the safety submission shows that the

⁵⁶ Safety Assessment Principles for Nuclear Facilities 2006 Edition, HSE, 2006, <http://www.hse.gov.uk/nuclear/saps/saps2006.pdf>

design of the plant is in conformity with the relevant SAPs, noting that not all of the principles are applicable to every licensed site. Some of the SAPs incorporate specific statutory limits. Apart from these, the SAPs should be met, so far as is reasonably practicable, which is a requirement of the HSWA74. There can, therefore, only be a rigid interpretation of those principles that reflect statutory limits. The SAPs were revised in 2006.

Technical Assessment Guides (TAGs) are used as guidance for ONR's specialist inspectors on the interpretation and application of the SAPs. There is also guidance for inspectors in the form of Technical Inspection Guides (TIGs). These set out the principles underlining the enforcement of licence condition compliance. The TAGs provide guidance in particular technical areas, and they are used at the discretion of inspectors. Copies of TAGs and TIGs are available on the ONR website⁵⁷

In relation to the safe management of radioactive waste on nuclear licensed sites, guidance has been issued by HSE in the form of TAST024⁵⁸ containing the following fundamental expectations:

- Production of radioactive waste should be avoided. When radioactive waste is unavoidable, its production should be minimised.
- Radioactive material and radioactive waste should be managed safely throughout its life cycle in a manner that is consistent with modern standards.
- Full use should be made of existing routes for the disposal of radioactive waste.

Remaining radioactive material and radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long-term solution.

Interdependencies in spent fuel and radioactive waste management

The handling treatment, storage and reprocessing of spent fuel, and the management of radioactive waste are all prescribed activities under NIA65. Therefore all such activities, including, where appropriate, storage and reprocessing at Sellafield or storage at another licensed site, is fully regulated by ONR. DfT-DGD regulates the transport of spent fuel from the reactor site to Sellafield, or other licensed sites. To ensure seamless regulation, DfT-DGD and ONR operate a MoU to ensure consistent and complementary regulation. ONR also operates a MoU with the environment agencies in England, Wales and Scotland to ensure that the environmental impact and safety of spent fuel management is effectively regulated.

Biological, chemical and other hazards

The biological, chemical or other hazards associated with the handling, treatment, storage, and where appropriate reprocessing of spent nuclear fuel are subject to HSWA74 and associated regulations such as the Control of Substances Hazardous to Health Regulations.⁵⁹ This comprehensive approach to regulation ensures that the licensee considers all hazards that could impact on the workers at the site, the public and the environment, and not simply those related to the radioactive hazard of such materials.

2.3.1.2 Environment Agencies Guidance

The environment agencies have published Guidance on Requirements for Authorisation for near-surface disposal facilities on land for solid radioactive wastes⁶⁰. This guidance applies across the UK. In

⁵⁷ HSE'S Internal Operational Instructions & Guidance - Nuclear Safety Directorate (NSD), <http://www.hse.gov.uk/foi/internalops/index.htm#3>

⁵⁸ Management of radioactive materials and radioactive waste on nuclear licensed sites, http://www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/tast024.pdf

⁵⁹ Control of Substances Hazardous to Health Regulations, 2002, SI 2677, <http://www.opsi.gov.uk/si/si2002/20022677.htm>.

⁶⁰ See <http://www.environment-agency.gov.uk/business/sectors/99322.aspx>

England, Wales and Northern Ireland, a policy of geological disposal of higher activity wastes has been adopted⁶¹. The Environment Agency and the Northern Ireland Environment Agency have published Guidance on Requirements for Authorisation for geological disposal facilities on land⁶². This guidance does not apply in Scotland, where a policy of long-term near surface, near site interim storage has been adopted.

Amongst other things, the two Guidance documents include a common fundamental protection objective with a supporting set of principles and requirements for disposal of solid radioactive waste to specialised disposal facilities on land. The **fundamental protection objective** is to ensure that all disposals of solid radioactive waste to facilities on land are made in a way that protects the health and interests of people and the integrity of the environment, at the time of disposal and in the future, inspires public confidence and takes account of costs.

The principles set out in the Guidance are:

- **Principle 1: Level of protection against radiological hazards at the time of disposal and in the future**

Solid radioactive waste shall be disposed of in such a way that the level of protection provided to people and the environment against the radiological hazards of the waste both at the time of disposal and in the future is consistent with the national standard at the time of disposal.

- **Principle 2: Optimisation (as low as reasonably achievable)**

Solid radioactive waste shall be disposed of in such a way that the radiological risks to individual members of the public and the population as a whole shall be as low as reasonably achievable under the circumstances prevailing at the time of disposal, taking into account economic and societal factors and the need to manage radiological risks to other living organisms and any non-radiological hazards.

- **Principle 3: Level of protection against non-radiological hazards at the time of disposal and in the future**

Solid radioactive waste shall be disposed of in such a way that the level of protection provided to people and the environment against any non-radiological hazards of the waste both at the time of disposal and in the future is consistent with that provided by the national standard at the time of disposal for wastes that present a non-radiological but not a radiological hazard.

- **Principle 4: Reliance on human action**

Solid radioactive waste shall be disposed of in such a way that unreasonable reliance on human action to protect the public and the environment against radiological and any non-radiological hazards is avoided both at the time of disposal and in the future.

- **Principle 5: Openness and inclusivity**

For any disposal of solid radioactive waste, the relevant environment agency shall:

- establish ways of informing interested parties and the public about regulatory goals, processes and issues;
- consult in an open and inclusive way.

⁶¹ Managing our Radioactive Waste Safely – <http://mrws.decc.gov.uk/>

⁶² See <http://www.environment-agency.gov.uk/business/sectors/99322.aspx>

The principles are accompanied by the following set of requirements that a developer/operator would need to address in developing a radioactive waste disposal facility.

- **Requirement R1: Process by agreement**

The developer should follow a process by agreement for developing a disposal facility for solid radioactive waste.

- **Requirement R2: Dialogue with potential host communities and others**

The developer should engage in dialogue with the planning authority, potential host community, other interested parties and the general public on its developing environmental safety case.

- **Requirement R3: Environmental safety case**

An application under the Radioactive Substances Act 1993 relating to a proposed disposal of solid radioactive waste should be supported by an environmental safety case.

- **Requirement R4: Environmental safety culture and management system**

The developer/operator of a disposal facility for solid radioactive waste should foster and nurture a positive environmental safety culture at all times and should have a management system, organisational structure and resources sufficient to provide the following functions: (a) planning and control of work; (b) the application of sound science and good engineering practice; (c) provision of information; (d) documentation and record-keeping; (e) quality management.

- **Requirement R5: Dose constraints during the period of authorisation**

During the period of authorisation of a disposal facility for solid radioactive waste, the effective dose from the facility to a representative member of the critical group should not exceed a source-related dose and a site-related dose constraint [These are defined in the Guidance].

- **Requirement R6: Risk guidance level after the period of authorisation**

After the period of authorisation, the assessed radiological risk from a disposal facility to a person representative of those at greatest risk should be consistent with a risk guidance level of 10⁻⁶ per year (i.e. 1 in a million per year).

- **Requirement R7: Human intrusion after the period of authorisation**

The developer/operator of a geological disposal facility should assume that human intrusion after the period of authorisation is highly unlikely to occur. The developer/operator should consider and implement any practical measures that might reduce this likelihood still further. The developer/operator should also assess the potential consequences of human intrusion after the period of authorisation.

- **Requirement R8: Optimisation**

The choice of waste acceptance criteria, how the selected site is used and the design, construction, operation, closure and post-closure management of the disposal facility should ensure that radiological risks to members of the public, both during the period of authorisation and afterwards, are as low as reasonably achievable (ALARA), taking into account economic and societal factors.

- **Requirement R9: Environmental radioactivity**

The developer/operator should carry out an assessment to investigate the radiological effects of a disposal facility on the accessible environment, both during the period of authorisation and afterwards, with a view to showing that all aspects of the accessible environment are adequately protected.

- **Requirement R10: Protection against non-radiological hazards**

The developer/operator of a disposal facility for solid radioactive waste should demonstrate that the disposal system provides adequate protection against non-radiological hazards.

- **Requirement R11: Site investigation**

The developer/operator of a disposal facility for solid radioactive waste should carry out a programme of site investigation and site characterisation to provide information for the environmental safety case and to support facility design and construction.

- **Requirement R12: Use of site and facility design, construction, operation and closure**

The developer/operator of a disposal facility for solid radioactive waste should make sure that the site is used and the facility is designed, constructed, operated and capable of closure so as to avoid unacceptable effects on the performance of the disposal system.

- **Requirement R13: Waste acceptance criteria**

The developer/operator of a disposal facility for solid radioactive waste should establish waste acceptance criteria consistent with the assumptions made in the environmental safety case and with the requirements for transport and handling, and demonstrate that these can be applied during operations at the facility.

- **Requirement R14: Monitoring**

In support of the environmental safety case, the developer/operator of a disposal facility for solid radioactive waste should carry out a programme to monitor for changes caused by construction, operation and closure of the facility.

The fundamental protection objective, the principles and requirements have supporting text providing detailed explanations of the regulators' expectations. Where necessary, the explanatory text provides specific guidance relevant to either a near-surface disposal facility or a geological disposal facility.

In developing the Guidance on Requirement for Authorisation due consideration was given to the basic principles for radioactive waste management set out in the IAEA Safety Fundamentals, published under the RADWASS programme, and to the Standards and Guides which flow from them.

2.3.1.3 Joint Guidance

The HSE, Environment Agency and SEPA published revised joint guidance on radioactive waste management in February 2010⁶³. The guidance applies to nuclear licensed sites and consists of an overview with four technical guidance modules covering (1) the regulatory process; (2) radioactive waste management cases; (3) waste minimisation, characterisation and segregation; and (4) managing information and records relating to radioactive waste. In addition, two modules covering (a) conditioning and disposability, and (b) storage of radioactive waste, have been issued for trial use by operators and regulators before being finalised.

The main aims of the guidance are to:

- provide a comprehensive source of information that can be used by nuclear site licensees and the regulators' staff, and referred to by other stakeholders; and
- advise licensees on how to obtain regulatory acceptance of their proposals for radioactive waste management.

The guidance should assist licensees by providing:

- a clear and transparent regulatory process involving early dialogue between the nuclear industry, the regulators, NDA and other stakeholders;
- much greater business certainty at a time when the nuclear industry is committing significant resources to radioactive waste management;
- a clear, auditable document trail of the basis for current regulatory decisions.

The joint guidance complements ONR's existing guidance to inspectors on nuclear safety cases and radioactive waste management^{64,65}.

The conditioning of radioactive wastes on nuclear licensed sites in the UK is regulated by the ONR under the terms of the conditions attached to the nuclear site licence. When assessing the suitability of a nuclear site licensee's safety case to treat radioactive waste, ONR consults the relevant environment agency. As part of this assessment process, ONR takes full and meaningful account of any environmental issues as advised to them, before issuing a consent or agreement. ONR seeks the relevant agency's advice in order to be satisfied that the proposal adequately addresses long-term environmental protection concerns, particularly those regarding the long-term disposability of the proposed waste form.

⁶³ The Management of Higher Activity Radioactive Waste on Nuclear Licensed Sites, Guidance from HSE, the Environment Agency and SEPA to Nuclear Licensees, February 2010.
<http://www.hse.gov.uk/nuclear/wastemanage.htm>

⁶⁴ Guidance on the purpose, scope and content of nuclear safety cases, Technical Assessment Guide T/AST/051, NSD, HSE www.hse.gov.uk/foi/internalops/nsd/tech_asst_guides/TAST051.pdf

⁶⁵ Guidance for inspectors on the management of radioactive materials and radioactive waste on nuclear licensed sites, HSE, March 2001, www.hse.gov.uk/nuclear/waste1.pdf

3. WASTE MANAGEMENT STRATEGY AND CURRENT PRACTICE

3.1 Waste classification and quantities

In the UK, radioactive waste is classified under the following broad categories, according to its heat-generating capacity and activity content:

- **High-level, or heat-generating, waste (HLW)**, in which the temperature may rise significantly as a result of their radioactivity, so that this factor has to be taken into account in designing storage or disposal facilities.
- **Intermediate-level waste (ILW)** with radioactivity levels exceeding the upper boundaries for low-level waste, but which do not require heating to be taken into account in the design of storage or disposal facilities.
- **Low-level waste (LLW)**, is now defined as radioactive waste having a radioactive content not exceeding 4 gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma activity. This definition is a general definition which does not relate to specific disposal sites.
- **Very Low Level Radioactive Waste (VLLW)**, a sub-category of LLW is defined as:

in the case of low volumes ('dustbin loads') – Low Volume VLLW:

“Radioactive waste which can be safely disposed of to an *unspecified* destination with municipal, commercial or industrial waste (“dustbin” disposal), each 0.1m³ of waste containing less than 400 kilobecquerels (kBq) of total activity or single items containing less than 40 kBq of total activity”

For wastes containing carbon-14 or hydrogen-3 (tritium):

- in each 0.1m³, the activity limit is 4,000 kBq for carbon-14 and hydrogen-3 (tritium) taken together; and
- for any single item, the activity limit is 400 kBq for carbon-14 and hydrogen-3 (tritium) taken together.

Controls on disposal of this material, after removal from the premises where the wastes arose, are not necessary.

or

in the case of bulk disposals – High Volume VLLW:

“Radioactive waste with maximum concentrations of four megabecquerels per tonne (MBq/te) of total activity which can be disposed of to specified landfill sites. For waste containing hydrogen-3 (tritium), the concentration limit for tritium is 40MBq/te. Controls on disposal of this material, after removal from the premises where the wastes arose, will be necessary in a manner specified by the environmental regulators”.

The principal difference between the two definitions is the need for controls on the total volumes of VLLW in the second (high volume) category being deposited at any one particular landfill site.

Most of the radioactive waste that arises in the United Kingdom originates from the nuclear power industry. This includes waste from the manufacture of fuel, reactor operations, decommissioning, spent fuel reprocessing and related research and development activities. Waste also arises from the defence programme, of which the major components are nuclear weapons production and the nuclear submarine propulsion programme. In addition, many medical, industrial, educational and research establishments produce small quantities of radioactive waste.

The 2010 UK Radioactive Waste Inventory recorded that approximately 5.03 million m³ of radioactive waste existed as at 1 April 2010 or was predicted to arise from the future operation of existing facilities. Of this 4.55 million m³ was LLW, 488,000 m³ was ILW and 1330 m³ was HLW.

3.2 Waste management strategy

3.2.1 Managing Radioactive Waste Safely

In 2001 the Government initiated the Managing Radioactive Waste Safely (MRWS) programme. The aim was to find a practicable solution to the UK's higher activity wastes that achieved long-term protection of people and the environment, inspired public confidence and ensured effective use of public monies. To assist the MRWS process and make recommendations, the Government set up an independent Committee on Radioactive Waste Management (CoRWM) in November 2003.

In October 2006 the Government accepted CoRWM's recommendations on geological disposal, coupled with safe and secure interim storage for legacy wastes. It also supported the recommendation to explore how a site selection approach based on voluntarism (an expression of interest by local communities in hosting a facility) and partnership with local communities could work in practice. As the next stage in the MRWS programme, in June 2007 the UK Government and devolved administrations for Wales and Northern Ireland consulted on proposals for the way in which a site will be chosen for the long-term disposal of higher activity radioactive waste.

On 12 June 2008 the UK Government and the devolved administrations for Wales and Northern Ireland published the Managing Radioactive Waste Safely White Paper (policy statement) (copy available at <http://mrws.decc.gov.uk/>). Local Authorities in England were invited to enter into discussions with Government, without commitment, about hosting a geological disposal facility. Welsh authorities were informed, and may choose to enter into discussions, though their Government has reserved its position on the policy of geological disposal. The Scottish Government policy is for long-term near-site, near-surface storage but continues to support long-term interim storage for higher activity radioactive waste and an on-going programme of research and development.

The Managing Radioactive Waste Safely White Paper sets out the technical programme to design and deliver a geological disposal facility and the process and criteria to be used to decide the siting of a facility. The key issues included were:

- the approach to compiling and updating the UK Radioactive Waste Inventory and using it as a basis for discussion with potential host communities;
- the Nuclear Decommissioning Authority's technical approach for developing a geological disposal facility, including the use of a staged implementation approach and ongoing research and development to support delivery;
- the arrangements to ensure sound regulation, scrutiny and control of the geological disposal facility;
- the process for issuing invitations and providing information to communities;
- how a partnership arrangement can be used to support a voluntarism approach;
- the use of affordable and value for money Engagement and Community Benefits Packages as part of the voluntarism and partnership approach;
- the initial sub-surface screening criteria and the way in which Government will apply these criteria;
- a refined set of criteria for assessing and evaluating candidate sites and details of further consultation on the way in which these criteria should be applied.

To date three local authorities have expressed an interest in entering into, without commitment, discussions with Government about the possibility of hosting a geological disposal facility for higher activity waste at some point in the future. These discussions are continuing.

The Scottish government did not sponsor the MRWS White Paper and has developed its own policy, which it published in January 2011. The Scottish Government Policy is that the long-term management of higher activity radioactive waste should be in near-surface facilities. Facilities should be located as near to the site where the waste is produced as possible. Developers will need to demonstrate how the facilities will be monitored and how waste packages, or waste, could be retrieved.

3.2.2 Low-level waste policy review

In 2007 the government issued a UK policy for managing solid low level radioactive waste setting out priorities for managing existing and future wastes from the nuclear energy industry and other sources. The Nuclear Decommissioning Agency (NDA) develop and publish a plan for the optimal use of the country's existing LLW repository near Drigg, Cumbria, which must include an assessment of when a future replacement might be required.

LLW management plans must take into account current and future quantities of LLW, and their radiological and non-radiological properties. Plans must be based on a risk-informed approach, to ensure safety and protection of the environment. Waste managers must seek to minimize waste through steps including waste avoidance, volume reduction, recycling and re-use. Plans must be based on an assessment of all practicable options for long-term waste management.

On the 5 June 2009 the NDA launched a consultation for the draft strategy for the Management of Solid Low Level Radioactive Waste from the UK Nuclear Industry⁶⁶. The proposed strategy will provide continued capability and capacity for the safe, secure and environmentally responsible management and disposal of LLW in the UK, for both the nuclear and non-nuclear industries through:

- application of the waste management hierarchy
- best use of existing facilities, working more efficiently and potentially extending the life of the existing national repository
- development and use of new fit for purpose management and disposal routes, so waste producers have more choice in determining implementing waste management routes.

3.3 Waste management issues at national level

The UK Government sought views on its proposed approach to site selection based on voluntarism and partnership in the Managing Radioactive Waste consultation June – November 2007. Taking account of the comments received, the UK Government decided to issue a public invitation to communities to express an interest in taking part in the siting process at the same time as the publication of the White Paper. The UK Government worked with the devolved administrations for Wales and Northern Ireland and the Nuclear Legacy Advisory Forum (NuLeAF) (a Special Interest Group of the Local Government Association) to publicise the invitation widely at the outset, particularly within local government. The UK Government continues to review what further activities to raise awareness of the invitation may be needed.

Recognising the need to provide potentially interested communities and others with accessible information on geological disposal, the UK Government worked with other sponsors of the White Paper

⁶⁶ At the time of writing the draft strategy and the environmental and sustainability report which underpins it are both available from www.nda.gov.uk.

and NuLeAF to set up a dedicated website for the MRWS Programme. This provides or links to detailed information on radioactive waste and its long-term management and is intended to be accessible to people with all levels of background knowledge.

3.4 Research and Development

3.4.1 *Research infrastructure*

Research and development on radioactive waste management is carried out by a number of organisations in the UK. The mains ones and the areas covered are:

- The NDA is responsible for carrying out research to underpin its activities. This responsibility is being carried both through direct funding, and co-ordinating work programmes of others. To help with this role a Research Board on Decommissioning and Clean-up in the UK has been established. This is discussed in more detail in section 4.4.
- NDA fund and co-ordinate research into the long-term management of wastes, including the behaviour of waste forms. Much of the work involves international collaboration.
- The licensees commission and undertake research to support the safe operation of their nuclear installations. In addition, the Government has given ONR the responsibility to co-ordinate a long-term generic (i.e. not site-specific) safety research programme to address the following objectives:
 - a) adequate and balanced programmes of nuclear safety research continue to be carried out, based on a view of the issues likely to emerge both in the short and long term;
 - b) as far as reasonably practicable, the potential contribution the research can make to securing higher standards of nuclear safety is maximised; and
 - c) the results of the research having implications for nuclear safety are disseminated as appropriate.

There are two secondary objectives:

- a) to take account of the desirability of maintaining a sufficient range of independent capability to ensure the attainment of the primary objective; and
 - b) to ensure that proper account is taken of the advantages of international collaboration in furthering the primary objectives.
- ONR directs the programme by identifying safety issues that are expressed in the Nuclear Research Index⁶⁷ The licensees use this index as a focus for commissioning the programme.
 - The Environment Agency's radioactive waste research and development programme focuses on requirements for the regulatory aspects of radioactive waste disposal within the Agency's broad remit for environmental protection.
 - SEPA has a small research budget, to fund research directly. SEPA also provides funding to the Scotland and Northern Ireland Forum of Environmental Research (SNIFFER) to support research projects in co-operation with other government bodies and regulators
 - Defra research funding addresses aspects such as radioactive waste inventory, contaminated land and radon.
 - As referred to earlier nuclear site operators carry out research (over and above the ONR programme) into various aspects concerned with the management of their own wastes, including wastefrom characterisation, retrieval and treatment.

⁶⁷ Nuclear Research Index. www.hse.gov.uk/research/nuclear/index.htm.

National Nuclear Laboratory

In April 2009 a contract for the Management of the National Nuclear Laboratory (NNL) was awarded to a consortium comprising Serco, Battelle and the University of Manchester. At the same time, the shares of the National Nuclear Laboratory were transferred from British Nuclear Fuels plc. to DECC. A Shareholder Executive will exercise shareholder responsibilities on behalf of DECC. The role of the contractor is to provide strategic vision and management to NNL and to develop it as a stand-alone business. The contract is for an initial three-year period, with options to extend by up to two years.

NNL provides services covering the complete nuclear fuel cycle from fuel manufacture and power generation, through to reprocessing, waste treatment and disposal and including defence, new nuclear build and security, supported by a range of links with international research organisations, academia and other national laboratories. It has facilities at Sellafield, Springfields, Windscale and Workington.

The objectives that DECC set out when NNL was established did not include a specific Research and Development (R&D) remit. In relation to the future development of nuclear energy, the Government is looking to commercial nuclear operators to deploy existing technology and expects therefore that further R&D will not be necessary in the near term. NNL has an R&D strategy through which it covers key research areas important for the organisation's growth and provides a focus for skills maintenance, which is a DECC objective. .

3.4.2 *Contents of R&D plans*

NDA research in support of its decommissioning mission is described in section 4.4. However the NDA also has responsibility for delivering a focused Research & Development programme to support geological disposal and optimised packaging solutions.

In March 2009, the NDA published a Research and Development Strategy to Underpin Geological Disposal of Higher-activity Radioactive Wastes and in February 2011 it published its R&D programme for the current preparatory phase of the project⁶⁸. Whilst there is sufficient research work available to be confident that geological disposal is technically achievable, this programme sets out further research during the geological disposal facility development process that will

- refine concepts;
- improve understanding of chemical and physical interactions in a disposal facility;
- address specific issues raised by regulators;
- support development of site-specific safety cases; and
- optimise facility design and delivery.

3.5 Financing of Radioactive Waste Management

3.5.1 *Framework and responsibilities*

3.5.2 *Status of financing schemes*

Please see section 4.5 for details of funding for waste management and decommissioning.

4. DECOMMISSIONING STRATEGY AND CURRENT PRACTICE

⁶⁸ Nuclear Decommissioning Authority, Geological Disposal: R&D Programme overview: Research and development needs in the preparatory studies phase, NDA Report NDA/RWMD/073, 2011

4.1 Decommissioning strategy

The Nuclear Decommissioning Authority (NDA) was set up in 2005 to take responsibility for the decommissioning and clean up of the UK's civil public sector nuclear sites previously owned and operated by British Nuclear Fuels Plc (BNFL) and the United Kingdom Atomic Energy Authority, (UKAEA). These sites are operated under contract to the NDA. The intention was to introduce competition into the management and operation of the NDA sites as a means of improving contractor performance and providing better value to taxpayers who are part-funding the decommissioning and clean up programme. To date the management of the LLWR and Sellafield have been successfully competed.

The NDA developed a national Strategy for how it will undertake its mission, including decommissioning and clean up. This strategy must be reviewed and published at least every five years. A new strategy was approved by UK Government and the Scottish Ministers in March 2011 Strategy II69 presents the outcome of a review of our first Strategy (ref 1) published in 2006. This revised Strategy sets out the strategic direction of the NDA and describes its long-term objectives.

The NDA also annually produces a three year rolling Business Plan which sets out how the NDA intends to implement this strategy in the short term and the allocation of resources across its estate. This business plan reflects site operators lifetime plans, which the NDA requires be underpinned by integrated and optimised waste strategies to ensure the ongoing need for waste treatment and disposal routes to support the delivery of these plans is identified and addressed. The NDA's Annual Report and Accounts provides details of how the NDA budgets are spent.⁷⁰

4.2 Status of decommissioning projects

The NDA has responsibility for the decommissioning of the UK's publicly owned civil nuclear sites. The NDA is responsible for 19 designated former UKAEA and BNFL facilities⁷¹:

- Sellafield - a large, complex nuclear chemical facility that has supported the nuclear power programme since the 1940s, and has undertaken work for a number of organisations including United Kingdom Atomic Energy Authority (UKAEA) and the Ministry of Defence (MoD). Operations at Sellafield include reprocessing of fuels removed from nuclear power stations; Mixed Oxide (MOX) fuel fabrication; and storage of nuclear materials and radioactive wastes alongside decommissioning.
- Dounreay – established in the mid-1950s as a research reactor site with fuel production and processing facilities. There were three reactors, the last of which ceased operation in 1994. These facilities are currently undergoing decommissioning and it is anticipated the site will reach its interim end state in around 2039.
- Harwell - established in 1946 as Britain's first Atomic Energy Research Establishment. The site accommodated five research reactors of various types. Decommissioning is well under way – two of the reactors have been completely removed, and the fuel has been removed from the remaining three which are now being decommissioning. More than 100 other facilities have been removed from the site and others are being decommissioned. It is expected that decommissioning will be completed around 2025.

⁶⁹ This is available from www.nda.gov.uk along with information on further strategy development which will inform the required five yearly of NDA's strategy which will conclude in 2010/2011.

⁷⁰ The NDA Annual Report and Accounts 2010/2011 can be found at <http://www.nda.gov.uk/documents/upload/Annual-Report-and-Accounts-2010-2011.pdf>

⁷¹ More information on these sites and the decommissioning plans is available from www.nda.gov.uk and in the NDA's Strategy.

- Winfrith - established by the UKAEA in 1958 as an experimental reactor research and development site. During its history, eight research reactors of various types have operated on the site. Six of the reactors have been removed from the site; the two remaining have had fuel removed and are in various stages of decommissioning. Parts of the Winfrith site have been delicensed and it is expected that the remaining decommissioning will be completed by around 2018.
- Springfields - established in the mid 1940s the site manufactures nuclear fuel products for the UK's nuclear power stations and for international customers. Fuel manufacture is scheduled to continue until 2023. In parallel with ongoing fuel manufacture, Springfields is also decommissioning redundant facilities on the site.
- Capenhurst - a uranium enrichment plant and associated facilities that ceased operation in 1982 and decommissioning is advanced. The site currently also has an ongoing role in storing nuclear materials.
- Low Level Waste Repository near Drigg - has operated as a national LLW disposal facility since 1959. Wastes are compacted and placed in containers before being transferred to the facility. Following a major upgrade of disposal operations in 1995, all LLW is now disposed of in engineered concrete vaults. Plutonium Contaminated Materials have been removed from the site for long-term storage at nearby Sellafield.
- 10 Magnox reactor sites which were first connected to the national grid between 1956 and 1971. The two most modern, Oldbury and Wylfa continue to generate electricity while the remaining sites, three are currently undergoing de-fuelling and the remainder are defuelled and are in the Care and Maintenance preparation (decommissioning) phase. It is currently planned that these sites will be placed into an extended period of care and maintenance following the removal of ancillary plant and the retrieval of operational wastes prior to final dismantling of the reactors themselves and the consignment of higher activity wastes. The business plan focuses on progress in decommissioning at two lead sites, Trawsfynydd, and Bradwell, with the aim of placing the first of these sites into care and maintenance in 2015.

As a result of the solvent restructuring of British Energy (BE) in 2002-05 the NDA is also charged with oversight of BE's nuclear liabilities associated with its current fleet of 7 AGR and 1 PWR power stations. This is because the Government have underwritten the funding of such liabilities in the event that the segregated decommissioning fund runs out. Under this BE, as the owner and licensee, are responsible for developing strategies and plans and the execution of decommissioning work, including ensuring the resultant wastes are acceptable for disposal. The NDA's role is to ensure that these represent value for money, that no funds go to supporting BE's commercial business. BE are currently planning for the decommissioning of their sites but as yet no station has moved into the pre-closure phase.

Information on the expected arising of radioactive waste from nuclear operations and decommissioning within the UK is presented in the UK Radioactive Waste Inventory⁷².

Current volumes of LLW expected to arise over the next century are currently estimated to exceed anticipated capacity in the national Low Level Waste Repository near the village of Drigg in Cumbria and this is one of the key drivers for the development of UK Strategy for the management of solid LLW from the nuclear industry described in section 3.3.

4.3 Decommissioning issues at national level

In the UK, decommissioning on a licensed nuclear site is regulated by HSE and now ONR under the nuclear site licensing regime. All the conditions attached to the licence apply to decommissioning

⁷² This inventory is updated periodically and the latest version - the 2010 inventory is available from www.nda.gov.uk/ukinventory.

activities. For decommissioning, the key element is the need for strategic planning. Licence Condition 35, which requires the licensee to make and implement adequate arrangements for the decommissioning of any plant that may affect safety, also requires the licensee to have decommissioning programmes. ONR has the power to direct the licensee to commence decommissioning in the interests of safety.

Government Policy⁷³ requires ONR, acting on HSE's behalf, in consultation with the environment agencies, to carry out five yearly ('quinquennial') reviews of licensee's decommissioning strategies to ensure that they remain soundly based as circumstances change. ONR requests, and leads the assessment of, licensee's decommissioning strategies. When it judges that the quinquennial review has been completed, it prepares and issues, in consultation with the environment agencies, a public statement..

In addition, EIADR99 requires ONR to consult the public before it gives its consent to the commencement of dismantling and decommissioning of power reactors.

A nuclear licensed site cannot be delicensed until ONR is satisfied that there is no danger from ionising radiation. Decommissioning is the process to achieve this end.

4.4 Research and development

4.4.1 Research Infrastructure

The NDA promotes and, where necessary, funds generic research relevant to the NDA mission. This funding is done either indirectly, via the Site Licence Companies (SLCs), or directly via either its Direct Research Portfolio (DRP) or RWMD's R&D department. The majority of the R&D is carried out by the SLCs and their supply chain. The DRP funds research which either informs strategy development or answers a generic multi-site issue, typically associated with encouraging innovation or maintaining key technical skills relevant to the NDA mission. All research projects are aligned with topic strategies from the NDA Strategy Management System. In 2010/11 direct funding of R&D by the NDA was £5 million.

The NDA also requires that the Lifetime Plans developed by the operators of its sites are technically underpinned and that any R&D gaps are identified. This is demonstrated by the Technical Baseline and Underpinning Research and Development document produced by each site. The NDA also promotes the sharing of information and good practice by means of the Nuclear Waste Research Forum (NWRP) and its associated sub-groups. A National R&D Board which includes key stakeholders (*e.g.* Government, Research Councils, Regulators) and independent members provides governance of the overall process.

The NDA has a relationship with a number of R&D supply chain organisations. In particular, the NDA engages with the National Nuclear Laboratory to coordinate the retention of key technical skills to support the NDA's mission on decommissioning and clean-up.

4.4.2 Contents of R&D plans

The NDA Direct Research Portfolio (DRP) is organised into four areas:

- University Interactions
- Waste Processing
- Materials Characterisation
- Actinides and Strategic Nuclear Materials

The first area, University Interactions, is concerned with maintaining key technical skills and encouraging innovation from within Universities. The other three areas are concerned with improving the technical baseline of existing strategies and technically underpinning alternative strategies. Overall the portfolio covers a wide range of projects ranging from fundamental understanding of the long-term stability

⁷³ Review of Radioactive Waste Management Policy – Final Conclusions, July 1995 (Cm2919), HMSO 1995, ISBN 0-10-129192-2. Not available on-line

of waste forms to developing processes to remove waste heels from redundant reaction vessels. Major current research projects include investigating alternative encapsulants for problematic wastes, improving the segregation of contaminated soils and building rubble during clean-up operations and investigating the options for the reuse or disposal of the UK's plutonium stock.

4.5 Financing

4.5.1 Framework and responsibilities

Each operator is expected to produce and maintain a decommissioning strategy and plans for its sites, and this is a requirement under of nuclear site licences. Such strategy should take into account all relevant factors, assessing and presenting them in a transparent way underpinned by objective information and arguments. These include the need to providing adequate funding.

The NDA has responsibility for contracting the operation of commercial and waste management operations on designated sites and for the eventual decommissioning of those sites. The current estimate for the cost of the clean-up programme for these sites is around £50 billion and the programme is likely to take over 100 years to complete. NDA is exploring ways in which the cost can be reduced and the timescales shortened, whilst still maintaining safety, security and environmental standards.

The NDA is funded by a combination of direct UK Government grant and income from commercial operations. Commercial income arises from two main areas: electricity generation and associated trading and spent fuel management, including reprocessing and manufacture of Mixed Oxide Fuel (MOX).. Initially the revenue from commercial operations made up approximately half of the NDA's total budget although this proportion will reduce over time as operational facilities enter decommissioning. The total budget for the period from 2011/12 to 2014/15 is £11.85 billion, of which £8.83 Billion will be provided directly by government.

British Energy's (BE's) liabilities associated with its existing nuclear fleet is funded from two sources, the arrangements for which were established as part of the solvent restructuring of BE in 2002-05:

- In respect of management of spent AGR fuel loaded into its reactors prior to its restructuring on 14 January 2005 and covered under historic contracts with BNFL (now the NDA), payments are made by the Department of Business, Innovation and Skills (BIS) under the terms of the Historic Liabilities Funding Agreement (HLFA);
- In respect of decommissioning of its existing power stations (including waste disposal), certain spent fuel management services beyond the scope of the historic contracts, and for Sizewell B spent fuel beyond the status quo at the time of restructuring, costs are met from the Nuclear Liabilities Fund (NLF). This is set out in the Nuclear Liabilities Funding Agreement (NLFA) and the Contribution Agreement. In the event that the NLF runs out of money then Government will contribute. The NLF is ring-fenced from Treasury and NDA and is administered by 5 Trustees, two selected by BE and three by Government. The fund currently stands at c. £8bn comprised of (i) contributions made by BE prior to its restructuring, (ii) contributions since restructuring, (iii) the proceeds from the sale of Government's shareholding in BE. These funding arrangements were accepted by the Competition Commission at the time of BE's restructuring.

4.5.2 Status of financing schemes

The NDA requires its sites to develop Lifetime Plans describing the work to be undertaken by its contractors. These plans cover the work required to operate and decommission these sites and are used to inform the total liabilities for which the NDA is responsible and the expected expenditure profile associated with NDA's decommissioning programme.

The NDA also acts on behalf of the Secretary of State for Energy and Climate Change in providing oversight of BE's planning-for and execution of the discharge of those of its liabilities covered under the NLFA. This is in order to minimise Government's exposure in the event that the existing fund, the NLF, runs short. Essentially the NDA treats BE in a similar manner to its own sites, noting that BE is the owner and license and thus responsible for the discharge of its liabilities. The NDA is responsible for authorising the associated decommissioning plans and approving all payments from the NLF.

ACRONYMS AND ABBREVIATIONS

AGR	Advanced gas cooled reactor
BAT	Best available technologies
BE	British Energy plc
BERR	Department for Business, Enterprise and Regulatory Reform (Formerly DTI, now Department of Business, Innovation and Skills (BIS))
BIS	Department of Business, Innovation and Skills
BNFL	British Nuclear Fuels plc
BPEO	Best practicable environmental option
BPM	Best practicable means
BSS Directive	EC Basic Safety Standards Directive 96/29/Euratom
CoRWM	Committee on Radioactive Waste Management
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DGD	Dangerous Goods Division (of DfT)
DOENI	Department of Environment Northern Ireland
DRP	Direct research portfolio
DTI	Department of Trade and Industry (replaced in June 2007 by BERR)
DWP	Department for Work and Pensions
EA95	The Environment Act 1995
EC	European Commission
EIA	Environmental impact assessments
EIADR99	Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulation 1999
Environment Agency (EA)	Environment Agency, for England and Wales
EPA90	Environmental Protection Act 1990
EPR10	Environmental Permitting (England and Wales) Regulations 2010
EU	European Union
Government	The UK Government and the devolved administrations, unless stated otherwise
HASS Regulations	High-activity Sealed Radioactive Sources and Orphan Sources Regulations 2005
HSC	Health and Safety Commission – merged with HSE 1 April 2008.
HSE	Health and Safety Executive
HLW	High Level Waste
HSWA74	Health and Safety at Work etc. Act 1974
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ILW	Intermediate Level Waste
IRR99	Ionising Radiations Regulations 1999
Joint Convention	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
LLW	Low Level Waste
LLWR	Low Level Waste Repository
MHSW99	The Management of Health and Safety at Work Regulations 1999
MoD	Ministry of Defence
MOP	Magnox Operating Plan
MoU	Memorandum of Understanding
MOX	Mixed-oxide fuel
MRWS	Managing Radioactive Waste Safely
mSv	milliSieverts
ND	Nuclear Directorate (formerly a part of HSE. Since 1 April 2011 within the Office for Nuclear Regulation (ONR))
NDA	Nuclear Decommissioning Authority
NIA65	Nuclear Installations Act 1965 (as amended)

NI	Northern Ireland Assembly
NIEA	Northern Ireland Environment Agency
NII	Nuclear Installations Inspectorate (formerly a part of HSE's Nuclear Directorate. Since 1 April 2011 within the Office for Nuclear Regulation (ONR))
NLF	Nuclear liabilities Fund
NLFA	Nuclear Liabilities Funding Agreement
NPP	Nuclear Power Plant
NRPB	National Radiological Protection Board
NuLeAF	Nuclear Legacy Advisory Forum
OCNS	Office for Civil Nuclear Security (formerly a part of HSE's Nuclear Directorate. Since 1 April 2011 within the Office for Nuclear Regulation (ONR))
OECD	Organisation for Economic Cooperation and Development
ONR	Office for Nuclear Regulation – an Agency of HSE established on 1 April 2011
OSPAR	The Convention for the Protection of the Marine Environment of the North East Atlantic (the “OSPAR” Convention), 1992
QQR	Five yearly (‘quinquennial’) review
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RIFE	Radioactivity in Food and the Environment
RSA93	Radioactive Substances Act 1993
RWMD	Radioactive Waste Management Directorate (a part of NDA)
SEPA	Scottish Environment Protection Agency
SG	Scottish Government
SLC	Site Licence Company
SNIFFER	Scotland and Northern Ireland Forum of Environmental Research
Thorp	Thermal Oxide Reprocessing Plant, at Sellafield
TOR	Tolerability of Risk
UK	United Kingdom of Great Britain and Northern Ireland
UKAEA	United Kingdom Atomic Energy Authority
UKRWI	UK Radioactive Waste Inventory
URAs	University Research Alliances
UKSO	UK Safeguards Office (formerly part of HSE’s Nuclear Directorate. Since 1 April 2011 within the Office for Nuclear Regulation (ONR))
VLLW	Very Low Level Waste
WG	Welsh Government
WAGR	Windscale Advanced Gas-cooled Reactor