National Audit Office

BRIEFING FOR THE HOUSE OF COMMONS ENERGY AND CLIMATE CHANGE SELECT COMMITTEE

APRIL 2012

The nuclear energy landscape in Great Britain

Our vision is to help the nation spend wisely.

We apply the unique perspective of public audit to help Parliament and government drive lasting improvement in public services.

The National Audit Office scrutinises public spending on behalf of Parliament. The Comptroller and Auditor General, Amyas Morse, is an Officer of the House of Commons. He is the head of the NAO, which employs some 880 staff. He and the NAO are totally independent of government. He certifies the accounts of all government departments and a wide range of other public sector bodies; and he has statutory authority to report to Parliament on the economy, efficiency and effectiveness with which departments and other bodies have used their resources. Our work led to savings and other efficiency gains worth more than £1 billion in 2010-11.

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Contents

Summary

1 This briefing provides an overview of nuclear energy in Great Britain, covering the nuclear industry, Government policy, the regulatory regime and arrangements for dealing with the legacy from previous nuclear generation. It has been prepared by the National Audit Office for the Energy and Climate Change select committee to inform its consideration of possible future inquiries on nuclear energy.

2 Nuclear power is the third largest source of electricity generation in Britain, accounting for 16 per cent of electricity supplies in 2010. The output from nuclear generation has, however, been in decline during the last decade. As at March 2012, following the closure of Oldbury nuclear power station in February 2012, there were 10.5 gigawatts of installed nuclear generating capacity compared to more than 12 gigawatts in 2000. Over the next eleven years all but one of Britain's ageing nuclear power stations are scheduled to close.

3 The closure of existing power stations could put at risk the achievement of the Government's aims to deliver secure, low carbon and affordable energy if new replacement low carbon generating capacity is not installed. The Government has identified a range of potential scenarios for market investment in new power stations and in energy efficiency that could achieve its aims. It is working to facilitate the delivery of nuclear power, with the aim of the first new nuclear power station (on current timetables) starting operations in 2019 and the subsequent deployment of further nuclear power stations helping to meet future demand for electricity. The Scottish Government has stated that it will not block applications to extend the lives of existing nuclear power stations in Scotland but it does not support the construction of new nuclear power stations, and there are no plans to build any in Scotland.

4 The Department of Energy and Climate Change (the Department) has established an Office for Nuclear Development to lead a programme of work aimed at enabling private sector companies to build and operate new nuclear reactors, without public subsidy. The Department's electricity market reform measures aim to guarantee the price that nuclear and other low carbon energy providers receive for the electricity they generate. The Energy and Climate Change Committee has previously highlighted that decisions on investing in new nuclear power stations are unlikely to be finalised before the details of the proposed low-carbon generation revenue support are confirmed, and delays could put at risk the achievement of the Department's indicative timeline for the first new nuclear power station to enter operation in 2019.

5 There are currently two companies that plan to build new nuclear power stations in Great Britain. EDF, which is 85 per cent owned by the French Government, plans to build two nuclear power stations with a generating capacity of 6.4 gigawatts at Sizewell and Hinkley Point. NuGeneration (a consortium of GDF Suez SA and

Iberdrola SA) have announced plans to build up to 3.6 gigawatts of capacity at Moorside, near Sellafield. Horizon Nuclear Power, a joint venture between RWE npower and E.ON, had planned to build 6 gigawatts of nuclear generating capacity in Britain by 2025, but in March 2012 it announced that following a strategic review it would not proceed with its plans.

6 There have been no new nuclear power stations built in Britain since 1995. There has been poor progress against cost and schedule in constructing the two new nuclear power stations in France and Finland that are using the Pressurised Water Reactor reactor design developed by Areva that has been proposed for the first of the new nuclear power stations in Britain. Areva is constructing a further two reactors of this design in China, and the first is scheduled to start operating in 2013. China is also using the other design that has been proposed for British power stations – the Westinghouse-designed AP1000 – and the first of the new reactors using this design is scheduled to enter operation in 2013.

7 At the end of their life, nuclear facilities must be dismantled, spent fuel removed, radioactive and other waste disposed of and land decontaminated. Many of the older nuclear facilities that are held in public ownership by the Nuclear Decommissioning Authority were not developed with decommissioning in mind and nuclear materials from early civilian and military activity were subject to poor management practice and neglect. On current estimates, it will cost taxpayers some £49 billion to decommission and clean-up this legacy. The Nuclear Liabilities Fund is responsible for meeting the estimated £4 billion cost of decommissioning nuclear power stations in Britain that are owned by EDF, although the Government will meet the cost if the assets held by the Fund, which as at 31 March 2011 were valued at £8.6 billion, are insufficient to meet liabilities when they arise. To minimise the risk that taxpayers have to meet the cost of decommissioning new nuclear power stations, the Government has stated that it will not give planning approval to build new reactors unless nuclear operators submit robust plans for funding the cost of decommissioning them and disposing of waste. It will, however, place a cap on the cost to nuclear operators of disposing of nuclear waste in a geological disposal facility. Preparatory studies are underway to identify potentially suitable sites for such a facility. Current indicative estimates suggest that 2040 would be the earliest date when waste could be placed in this facility.

8 The Government has revised the regulatory structure for nuclear energy with the aim of efficiently and effectively addressing the challenges associated with the historic nuclear legacy and the development of new nuclear power stations. The Office for Nuclear Regulation was established as an Agency of the Health and Safety Executive, in April 2011, bringing together functions previously undertaken by the Nuclear Installations Inspectorate, the Office for Civil Nuclear Security, the UK Safeguards Office. In June 2011 it took over responsibility for the Department for Transport's Radioactive Materials Transport Team. It is recruiting 80 additional inspectors to add to its existing 436 staff over the two years from February 2012, and is working alongside the Environment Agency on assessing new nuclear reactor designs. The Government expects to bring forward legislation to give the Office for Nuclear Regulation statutory independence from 2014.

Key developments and risks

9 The Department does not intend to prevent the continued operation of existing nuclear power stations in Britain following a review of lessons from the nuclear accident at Fukushima in Japan, but it is reviewing its approach to national emergency planning. The review includes clarifying requirements for radiation monitoring capacity and ensuring that fire, ambulance and police services have a clear understanding of tolerable radiation exposure levels when responding to nuclear emergencies. It is also taking forward an amendment under the "Paris" Convention to increase the limit on nuclear operators' financial liabilities for nuclear accidents at sites in Great Britain from around €160 million to €1.2 billion.

10 All but one of Britain's existing nuclear energy stations is scheduled to close within the next eleven years if their lifetimes are not extended, and there is a tight timeline for securing new low carbon electricity generation capacity to meet future demand for electricity. The Department's indicative timeline for the first of a new generation of nuclear power stations in Britain is for it to be built by 2019. The principal challenges involved will be whether proposed new electricity market mechanisms and agreement over funded decommissioning plans will make investment in new nuclear power stations commercially viable, while achieving value for money for consumers; whether the planning and regulatory processes result in the necessary consents being granted in sufficient time to allow investment decisions to be taken; and whether the power stations can then be built to time and cost.

11 Experiences in other European countries suggest that there is a significant risk that new nuclear power stations will not be delivered to planned timetables. Construction will have to progress in line with demanding timetables if the first new nuclear reactor is to be completed by 2019. Two new nuclear power stations that are under construction in France and Finland and using the same generic design of reactor that has been proposed for the first new nuclear power station in Britain are currently several years behind schedule and, in total, €5.1 billion (77 per cent) over budget.

12 Global demand for nuclear power or changes in strategic priorities could put pressure on plans to build new nuclear power stations in Britain. One of the consortia that had planned to build new nuclear power stations in Britain has chosen not to proceed with its plans following a strategic review. There are 60 new nuclear power stations currently under construction worldwide and a further 150 planned. Increasing demand could put pressure on the resources of the relatively small number of companies that have the skills, capacity and finance to build and operate new nuclear power stations.

13 Increased demand for nuclear power could increase the risk of a global shortage of fuel supplies. The Department considers that if existing supplies of uranium were exhausted, more expensive sources of uranium could potentially be used. Alternatively, spent fuel could be reprocessed. Research is also being carried out into the scope for using alternative fuels such as thorium.

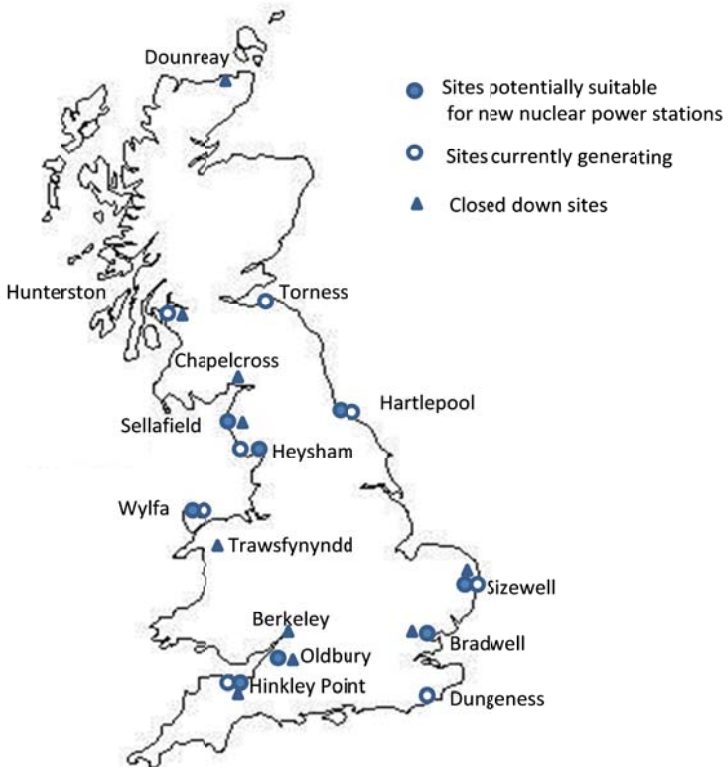
14 The development of nuclear energy in Britain has left a decommissioning legacy that will cost taxpayers an estimated £49 billion (discounted to present values). There are considerable uncertainties in this estimate, and during the last decade the estimated cost has grown significantly. The Nuclear Decommissioning Authority's spending on decommissioning and clean-up accounted for 29 per cent of its £2.8 billion budget in 2010-11.

15 Intermediate and high level waste will have to be held in interim storage for several decades until a solution for long term disposal has been implemented. The Government's preferred option is to dispose of intermediate and high level waste in a geological disposal facility. However, it will take several years to identify a suitable site and a community willing to host the facility and then build it. Current indicative estimates suggest that 2040 would be the earliest date when waste could be placed in this facility.

Part One

Nuclear Energy in Great Britain

The nuclear energy infrastructure



Source: National Audit Office

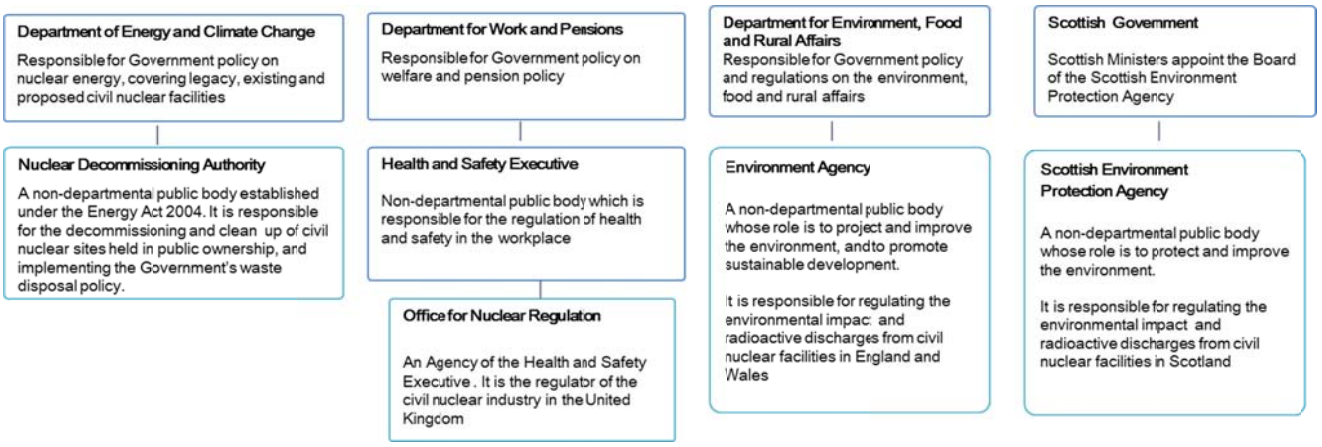
1.1 Britain's nuclear energy infrastructure comprises a mixture of operational nuclear power plants, closed power stations in various stages of decommissioning, fuel fabrication, reprocessing and research and development facilities. There are also various other military, medical and industrial sites that use radioactive materials, but this briefing focuses on the energy industry.

1.2 The oldest nuclear power station still operating in Britain, at Wylfa in Wales, is owned by the Nuclear Decommissioning Authority, which also holds all other publicly owned civil nuclear energy facilities, including Sellafield. A further eight operational power stations with a total generating capacity of 9.6 gigawatts are owned by EDF Energy Nuclear Generation Ltd., a wholly owned subsidiary of EDF. EDF operates 74.6 gigawatts of nuclear generation globally and is the largest nuclear operator in the world. It is planning to build two new nuclear power stations in Britain with a combined

generating capacity of 6.4 gigawatts at Hinkley Point and Sizewell. EDF is 85 per cent owned by the French Government. In February 2012, the UK and French Governments signed an agreement to stimulate a Franco-British nuclear industry including through EDF's contracting for the construction of new reactors.

1.3 There are two other companies that have announced plans to build new nuclear power stations in Britain, with a proposed capacity of 9.6 gigawatts. NuGeneration (a consortium of GDF Suez SA and Iberdrola SA) have announced plans to build up to 3.6 gigawatts of capacity at Moorside, near Sellafield. Horizon Nuclear Power, a joint venture between RWE npower and E.ON, had planned to build 6 gigawatts of nuclear generating capacity in Britain by 2025, but in March 2012 it announced that following a strategic review it would not proceed with its plans.

The domestic regulatory and legal framework



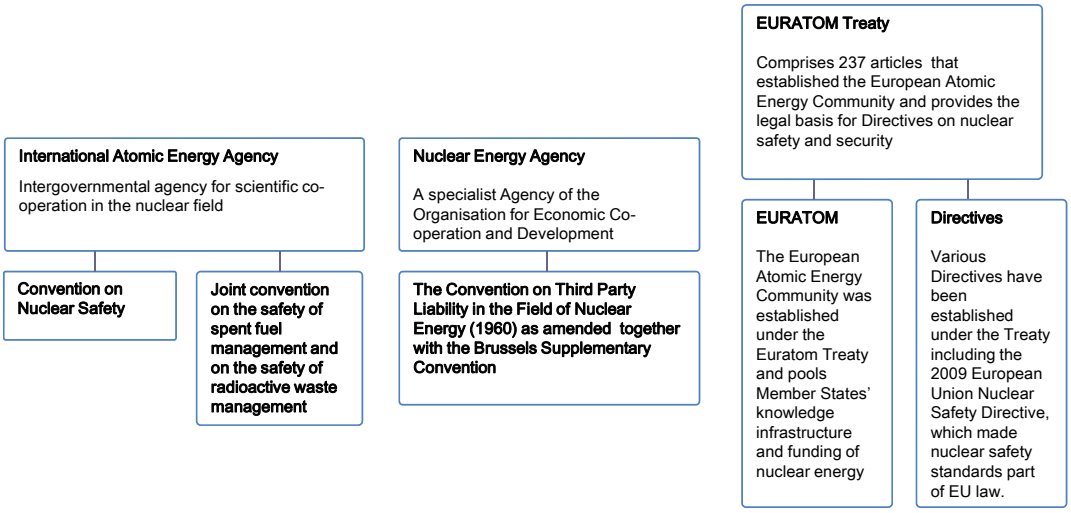
Source: National Audit Office

1.4 Operators of nuclear facilities, like their counterparts in other industries, are required to comply with the Health and Safety at work Act 1974. They are also subject to the nuclear site licencing system set out in the Nuclear Installations Act 1965 and the Ionising Radiations Regulations 1999. The nuclear site licensing regulations require licensees to adhere to general principles set by the Office for Nuclear Regulation, which checks that licensees have the procedures and technology in place to meet certain general principles. The Office for Nuclear Regulation has powers to issue various types of consents, directions and specifications. For example, it can require licensees to take specific action, such as shutting down a facility. This regime contrasts with those used in most other countries, which involve the setting of prescriptive rules that licensees must follow so that their compliance can be checked.

1.5 The Department of Energy and Climate Change has overall responsibility for policy on safety at civil nuclear sites and the Office for Nuclear Regulation, which is an agency of the Health and Safety Executive, administers the licensing system. The Office for Nuclear Regulation was created in April 2011 to bring together functions previously carried out by the Nuclear Installations Inspectorate, the Office for Civil Nuclear Security, the UK Safeguards Office and the Department for Transport's Radioactive Materials Transport Team. The Government's intention in establishing the Office for Nuclear Regulation was to ensure that it could efficiently and effectively address the challenges associated with the historic nuclear legacy and the development of new nuclear power stations. The Office for Nuclear Regulation is recruiting 80 additional inspectors to add to its existing staff of 436 over the two years from February 2012 to meet these challenges. The Government plans to legislate for the Office for Nuclear Regulation to be established as an independent regulator in 2014.

1.6 The disposal of radioactive waste by and from nuclear sites is subject to the Environmental Permitting Regulations 2010 in England and Wales and the Radioactive Substances Act 1993 in Scotland. Permits issued by the Environment Agency (in England and Wales) and the Scottish Environment Protection Agency (in Scotland) set limits and conditions on the amount and method of waste disposal, covering discharges to air and water, and transfers of waste for incineration or disposal to land. The Environment Agency (and its Scottish counterpart) and the Office for Nuclear Regulation have independent responsibilities, but have a memorandum of understanding that aims to align their processes and regulatory positions wherever possible.

The international regulatory and legal framework



Source: National Audit Office

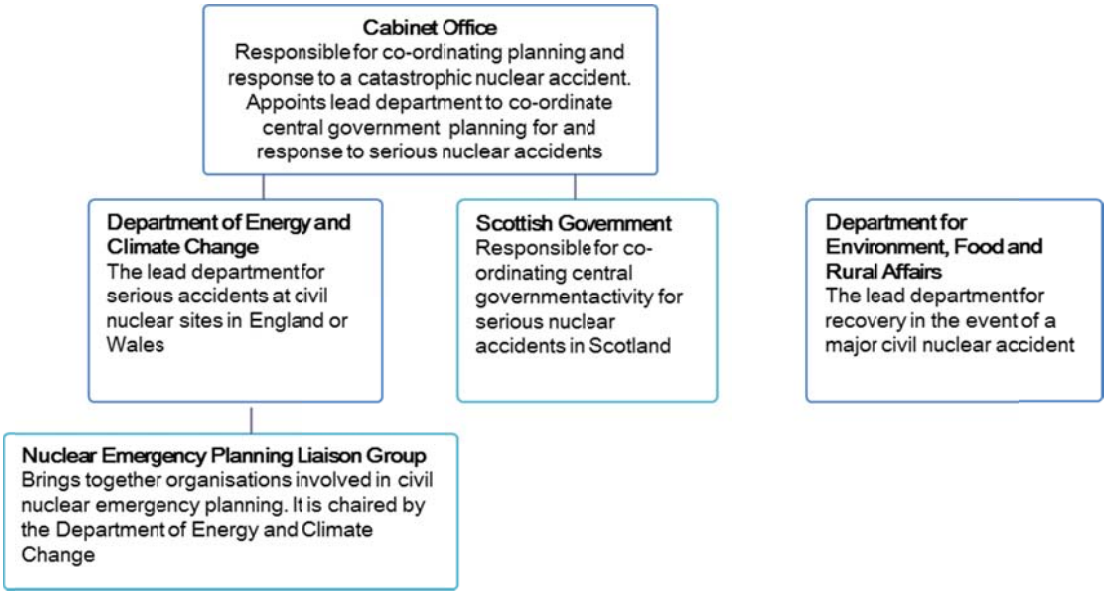
1.7 The UK is a member of the International Atomic Energy Agency, which promotes the safe use of radioactive substances through a series of Safety Standard documents; and the Nuclear Energy Agency, which aims to help members make safe, environmentally-friendly and economic uses of nuclear energy for peaceful purposes. It is also a signatory to binding international conventions established under the auspices of these organisations:

- The Convention on Nuclear Safety (1994) places obligations on signatories to maintain high levels of safety and sets international benchmarks.
- The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997) places obligations on signatories to establish and maintain a legislative and regulatory framework governing spent fuel and radioactive waste management to ensure that individuals, society and the environment are adequately protected.
- The Convention on Third Party Liability in the Field of Nuclear Energy (1960) as amended, together with the Brussels Supplementary Convention, establishes a framework, which has been applied mostly in Western Europe, for compensating victims of a nuclear incident. The Conventions establish strict and exclusive liability on operators as well as requiring them to have insurance to cover their liability. In return, operator liability is limited. In the UK it is limited to £140 million per incident. The Convention was revised in 2004 to strengthen the regime and increase operator liability to a minimum of €700 million. The UK Government has completed its public consultation process on the changes and proposes increasing operator liability to €1.2 billion.

1.8 As a Member State of the European Union, the UK is bound by legislation relating to radioactive substances made under the Euratom Treaty, which provides for the establishment of uniform basic safety standards to protect the health of workers and the general public against the dangers arising from ionising radiation. The 2009 European Union Nuclear Safety Directive, established under this Treaty, created a high level nuclear safety framework as part of EU law that is enforceable before the European Court of Justice. It represented the first step towards the harmonisation of nuclear safety approaches across the EU. The Radioactive Waste and Spent Fuel Management Directive, which was adopted in July 2011, requires member states to submit national programmes for waste management to the Commission by 2015 for approval.

1.9 There is also a range of international environmental agreements that are relevant to Britain's nuclear sector, including the Ospar Convention which is designed to prevent and eliminate marine pollution including from radioactive discharges.

Nuclear security and emergency planning



Source: National Audit Office

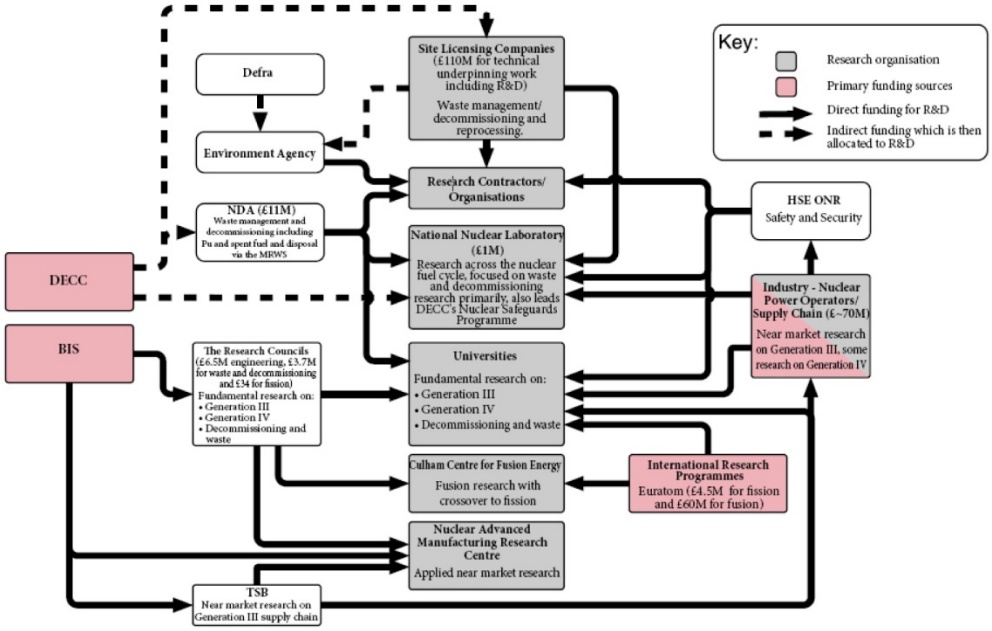
1.10 In addition to legislation that requires the civil sector nuclear installations to operate within a strict regulatory regime and achieve the highest standards of safety and environmental impact, operators of civil nuclear sites are also subject to the Radiation (Emergency Preparedness and Public Information) Regulations 2001. These regulations place obligations on licensees to produce an emergency plan for dealing with any reasonably foreseeable radiation emergency, as well as providing prior information to the population around the site. The Regulations also place duties on the local authority in whose area the site is based to prepare offsite emergency plans. Operators of licensed sites are required to meet the cost of the Civil Nuclear Constabulary, which is an armed police service that is responsible for protecting licenced civil nuclear sites and safeguarding nuclear material in Great Britain.

1.11 Central Government activity is co-ordinated by a lead department nominated by the Cabinet Office's National Security Council, Sub Committee on Threats, Hazards, Resilience and Contingencies. For serious accidents at civil nuclear sites in England or Wales this is the Department of Energy and Climate Change and in Scotland it is the Scottish Government. The Department chairs the nuclear emergency planning liaison group which brings together organisations with interests in off-site civil nuclear emergency planning. Response to a "catastrophic" accident would be led by the National Security Council at the Cabinet Office Briefing Room.

1.12 In response to a report that the Secretary of State for Energy and Climate Change commissioned from Dr Mike Weightman on lessons from the nuclear accident at Fukushima in Japan, the Department of Energy and Climate Change is taking forward a programme of work to strengthen the UK's national nuclear emergency arrangements, including clarifying requirements for radiation monitoring capacity and ensuring that fire, ambulance and police services have a clear understanding of tolerable radiation exposure levels in emergencies.

1.13 The lead department for dealing with recovery in the event of a major civil nuclear accident in England is the Department for Environment, Food and Rural Affairs. In Wales, it is the Welsh Assembly Government, in Scotland, the Scottish Government, and in Northern Ireland, the Northern Ireland Executive.

Research and Development



Source: House of Lords Science and Technology Committee

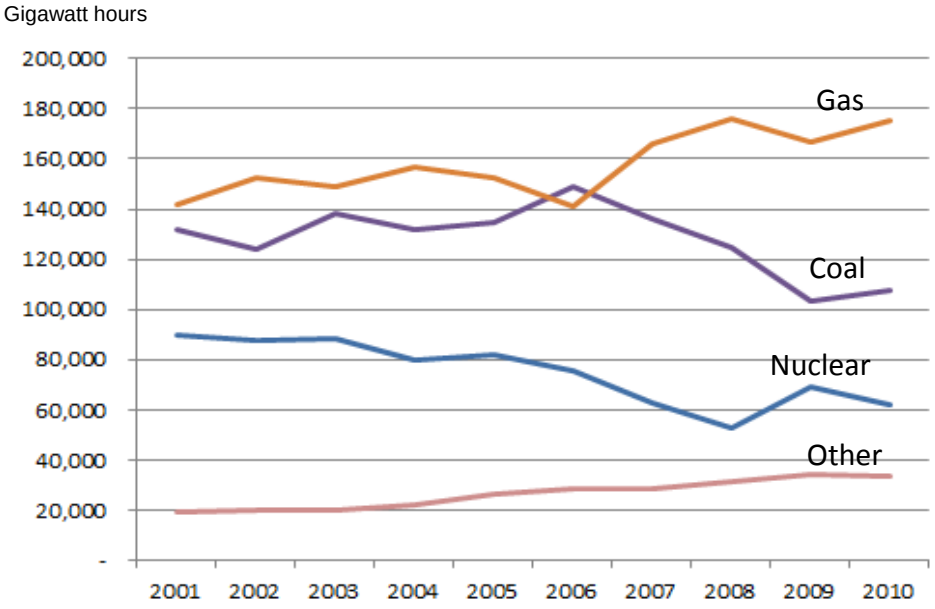
1.14 Most nuclear reactors operating today are thermal fission reactors, in which fast-moving neutrons released in the fission process must be slowed down in a moderator, such as water, before they can sustain the chain reaction. Current nuclear research and development includes work to develop a new generation of fast neutron reactors, which have existed for decades but have never been widely exploited commercially, that can extract at least 50 times more energy than current reactors from a given quantity of uranium. The various technical challenges to commercial development are being investigated as part of a global research effort. Other areas of research include the physics and engineering basis for nuclear fusion, and the use of alternative fuel sources such as thorium.

1.15 A range of public and private sector organisations are involved in conducting research and development on nuclear power in Britain. The main providers of public funding are the Research councils and Euratom, which together spend around £110 million annually on nuclear research and development in Great Britain. The other key funders of nuclear research and development are the Nuclear Decommissioning Authority, which annually spends around £121 million directly and through its contractors on waste management decommissioning research, and the power companies that spend an estimated £70 million on research and development on nuclear generating technologies. The House of Lords Science and Technology Committee concluded in November 2011 that the Government was not doing enough to maintain and develop UK nuclear research and development capabilities and that the UK's strengths in nuclear research and development and expertise were built on past investments that would soon be depleted as experts near the end of their careers. The Government has accepted that more can be done, and intends to publish a long-term strategy in Summer 2012 on the role of nuclear up to 2050, which will include options for maintaining relevant research and development capabilities.

Part two

Existing nuclear energy generation

Electricity generated in Britain



Source: Department of Energy and Climate Change

2.1 Nuclear power is the third largest source of electricity in Britain, and in 2010 accounted for 16 per cent of the UK's total electricity supplies. During the third quarter of 2011 it increased to 19 per cent due to several stations returning into use after maintenance outages including at Sizewell B, which was offline for six months in 2010 following the failure of some heaters in a component known as the pressuriser. There has been an overall decline in the supply of electricity from nuclear power stations over the last decade due to the closure of nuclear power stations that had reached the end of their operating life. The closure of Oldbury nuclear power station in February 2012 resulted in a further decline in the proportion of electricity generated using nuclear power.

2.2 As at March 2012, there were nine nuclear power stations operating in Britain containing 17 nuclear reactors. One of these power stations–Wylfa power station in Anglesey - is held in public ownership. It started generating in 1971 and its two reactors have a total generating capacity of 980 megawatts, although one of these reactors is due to close in April 2012. It is managed by Magnox Limited, which is owned by the American company EnergySolutions, under contract to the Nuclear Decommissioning Authority.

2.3 The other eight nuclear power stations are owned by EDF Energy Nuclear Generation Ltd (formerly British Energy), which is a wholly-owned subsidiary of EDF. EDF purchased the company in January 2009 for £12.5 billion, which included a payment of £4.4 billion for the Government's interest in British Energy. The acquisition of British Energy increased EDF's share of the UK's electricity generating capacity from 6 per cent to 17 per cent, and continued a trend of consolidation and vertical integration. British Energy's nuclear reactors have an installed capacity of 10.5 gigawatts, or 14 per cent of its global installed nuclear capacity of 74.6 gigawats.

Scheduled closure of existing nuclear power stations

Name	Capacity (MW)	Date came into operation	End of life as at March 2012
Magnox (Nuclear Decommissioning Authority)			
Wylfa	980	1971	2014
Advanced gas cooled reactor (former British Energy sites now operated by EDF Energy)			
Heysham 1	1,150	1983	2019
Hinkley Point B	1,220	1976	2016
Hunterston B	1,190	1976	2016
Dungeness B	1,110	1985	2018
Hartlepool	1,210	1983	2019
Heysham 2	1,250	1988	2023
Torness	1,250	1988	2023
Pressurised water reactor – (former British Energy sites now operated by EDF Energy)			
Sizewell B	1,188	1995	2035

Source: Department of Energy and Climate Change

2.4 There are three different types of reactors used in nuclear power stations operating in Britain. The oldest design is the magnox gas-cooled reactor. Only one of the 11 magnox reactors that were constructed in Britain is still operating. These reactors were designed to have an operating life of around twenty years. However, life extensions were granted to many of these reactors, and the remaining magnox reactors at Wylfa have been operating for 41 years. One of the two reactors at Wylfa is scheduled to reach the end of its life in April 2012, because of a shortage of fuel used in this type of reactor, but the other could potentially operate until September 2014.

2.5 The second type of reactor is the advanced gas-cooled reactor. All seven power stations that were built using this reactor design are still operating, but they are scheduled to close between 2016 and 2023. In 2005, Dungeness received a ten year life extension to 2018 and in 2008 the Hinkley B and Hunterston B reactors received a five year extension to 2016.

2.6 The last nuclear power station to be built in the UK, at Sizewell, used the pressurised water reactor design. This is the most common type of design used in commercial nuclear power stations worldwide. During 2010, the reactor at Sizewell was closed for six months due to an unplanned outage. EDF Energy publishes details of the operating status of its reactors online.[1] As at 19 March 2012, eight of its fourteen advanced gas reactors were in service, two had been shut down due to unplanned outages and four had been shut down as part of planned outages. One of the two turbines at Sizewell B had also been closed due to an unplanned outage.

[1] http://www.edfenergy.com/about-us/energy-generation/nuclear-generation/nuclear-power-stations/station-reports/nuclear-plant-status/nuclear-plant-status.pdf

The European context

Country	Reactors in operation (construction)	Nuclear electricity as % of total electricity generated
Belgium	7	51.2
Bulgaria	2 (2)	33.1
Czech Republic	6	33.3
Finland	4 (1)	28.4
France	58 (1)	74.1
Germany	17	27.3
Hungary	4	42.1
Romania	2	19.5
Slovakia	4 (2)	51.8
Slovenia	1	37.3
Spain	8	20.1
Sweden	10	38.1
The Netherlands	1	3.4
United Kingdom	19	15.7
Total	143 (6)	

Source: Euratom Supply Agency

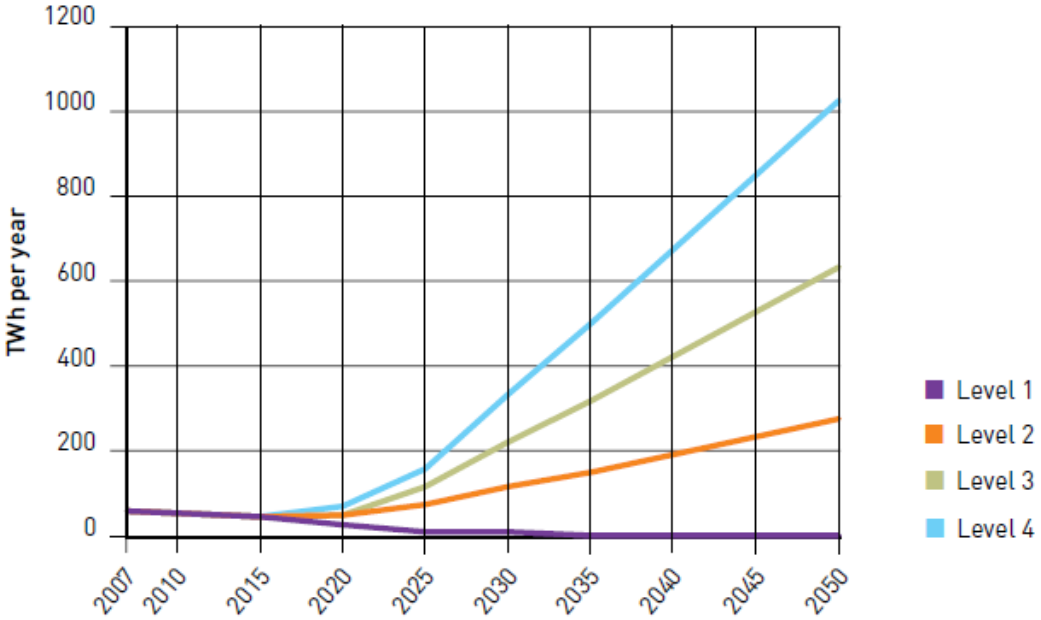
2.7 In 2010, there were 143 nuclear reactors operating in the European Union and six under construction. Across the 14 Member States that have nuclear power stations, in 2010 the UK had the second largest number of reactors but the second lowest percentage of electricity generated from nuclear power. One contributing factor to this overall position is the relatively poor performance of British nuclear power stations in terms of their load factor, which measures actual average output as a percentage of total capacity. Nuclear power stations in Britain had an average load factor of 59.4 per cent in 2010. The World Nuclear Association estimates that one quarter of all reactors globally have load factors of more than 90 per cent and nearly two thirds have load factors of more than 75 per cent.

2.8 The two new reactors that are under construction in Finland and France are pressurized water reactors of the same generic design that EDF intends to install in Britain. The new power plants that are under construction in Bulgaria and Slovakia are using Russian-designed reactors. In March 2012 the Bulgarian Government announced that the construction of its two new nuclear reactors, which are forecast to cost €8 billion, would not proceed unless sufficient funding for the project could be found.

Part Three

Plans for new nuclear generating capacity

The Department's modelling of the future growth in nuclear energy under different illustrative scenarios



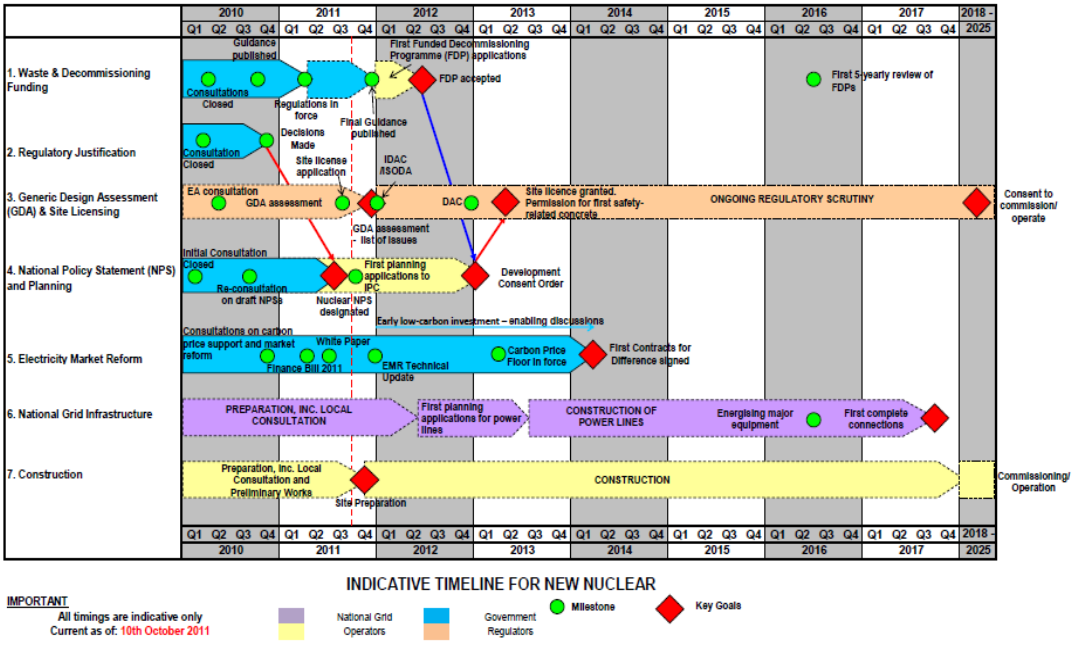
Source: Department of Energy and Climate Change

3.1 The Government considers nuclear power to have an important role to play alongside renewable energy and carbon capture and storage in meeting the UK's future energy needs. The Government is supportive of energy companies building new nuclear power stations, subject to the normal planning process for major projects, but has stated that it will provide no public subsidy for nuclear power.

3.2 The Department has produced in its 2050 pathways analysis a range of illustrative scenarios for the development of nuclear power over the next few decades. Level 1 assumes that no new nuclear stations are built, with nuclear electricity generation ceasing after the scheduled closure of Sizewell B in 2035. Level 4 represents the Department's assessment of the maximum nuclear capacity that is technically feasible, but this scenario does not take into account the associated risks and costs of achieving this. In this scenario, 6 gigawatts of nuclear energy would have been installed by 2020, increasing to 146 gigawatts by 2050.

3.3 The nuclear industry has previously announced plans to build new reactors with a total generating capacity of 16 gigawatts by 2025. The delivery of these plans is dependent on meeting the various regulatory and planning requirements and on the commercial case for and affordability of building new nuclear power stations in the UK. Horizon Nuclear Power, a joint venture between RWE npower and E.ON, announced in March 2012 that it would not proceed with plans to build 6 gigawatts of nuclear generating capacity in Britain by 2025, which has reduced the planned generating capacity for new nuclear power stations in Britain to 10 gigawatts.

The Government's Indicative timeline for new nuclear power stations



NOTE

This timeline predates EDF's planning application for Hinkley Point C, which set an operational date of 2019.

Source: Department of Energy and Climate Change

3.4 The Department of Energy and Climate Change has established within it an Office for Nuclear Development to lead its work to facilitate the deployment of new nuclear power. The Office for Nuclear Development has published an 'indicative timetable' for installing new nuclear power capacity in Great Britain. This shows the various milestones that must be passed to deliver the first of a new generation of nuclear power stations by 2019.

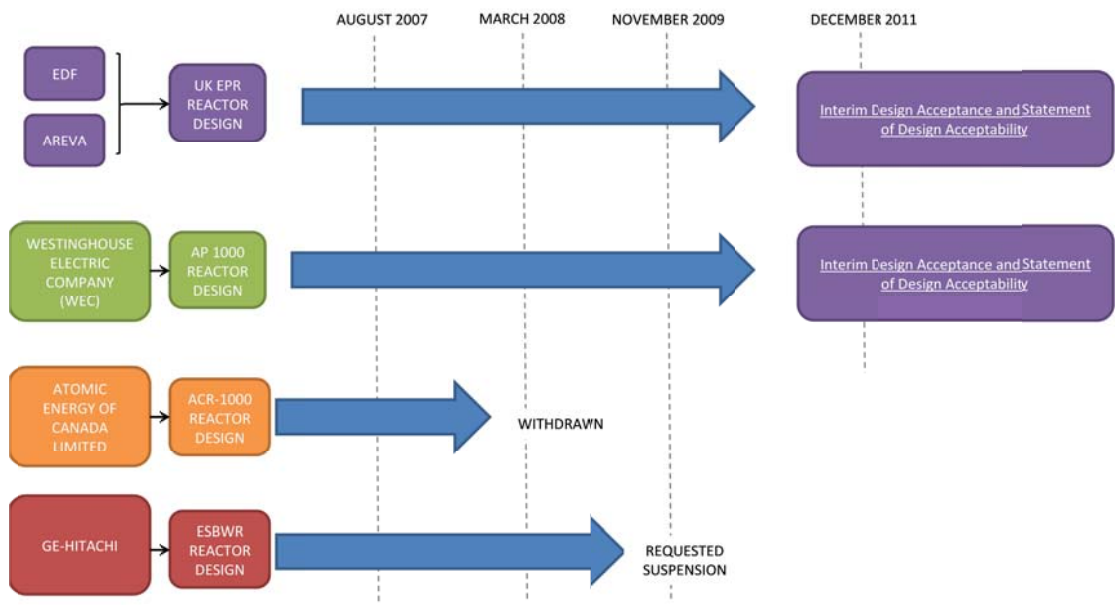
3.5 The Department has met its first key milestone, which was to confirm the "regulatory justification". This is a requirement under European Law[2] for any new class or type of practice involving ionising radiation, including nuclear power stations, to undergo a generic, high-level assessment of whether the social, economic or other benefits outweigh the health detriment. The "Justifying Authority" for nuclear energy is

[2] European Council Directive 96/29/Euratom of 13 May 1996. In the UK, this principle is set out in the Justification of Practices Involving Ionising Radiation Regulations 2004

the Secretary of State for Energy and Climate Change, and his decisions that the benefits of the two types of nuclear reactors he examined outweighed any radiological health detriment they may cause was published in October 2010. These decisions were subject to applications by a member of the public for permission to apply a judicial review, but the Court determined that the Secretary of State's decision was lawful.

3.6 The next key milestones that will need to be achieved are to complete the Generic Design Assessment process, to award Development Consent Orders to construct new power stations and to approve nuclear operators' Funded Decommissioning Programmes (which set out how the cost of decommissioning and waste disposal stations will be met).

The Generic Design Assessment process



Source: National Audit Office

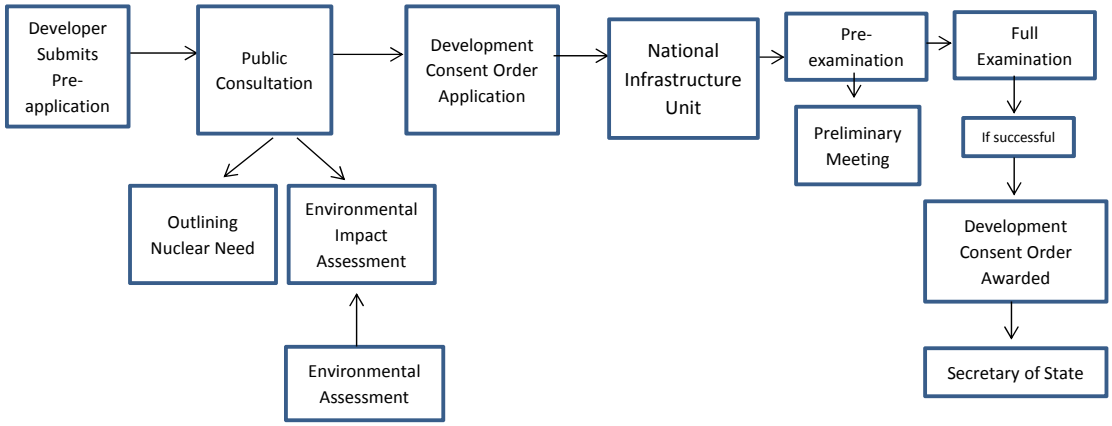
3.7 The Generic Design Assessment process was introduced in 2007 as a voluntary process that operates alongside the existing legislative framework set out in the Nuclear Installations Act 1965 and other relevant legislation. It allowed the Office for Nuclear Regulation and the Environment Agency to carry out an early assessment of the safety, security and environmental aspects of nuclear reactor designs before their consideration of licence and permit applications. The overall aim was to allow any issues to be identified and corrected at the design stage, based on reviews of the safety features and acceptability of generic nuclear reactor designs. If the applicant is successful, they receive "Design Acceptance" for the reactor design. Applicants subsequently have to apply for a licence to construct individual reactors at specific sites.

3.8 The Assessment process consists of a series of steps that become increasingly detailed at each stage. Technical reports are produced after each step to provide an indication of how the assessment is progressing and to highlight potential issues that will need to be resolved during the following step. The Environment Agency and Office for Nuclear Regulation have established a Joint Programme Coordination Team and a Joint Programme Office to administer the process.

3.9 Four separate designs were put forward for assessment, but two were subsequently withdrawn because the applicants stated they wanted to focus on getting their designs certified in their own countries. The remaining two designs received interim design acceptance in December 2011, but further work is required if they are to obtain full consent. Westinghouse informed the regulators that it does not intend to address any of the issues raised in the Generic Design Assessment until it has a confirmed UK customer, and further work on assessing the design of this reactor has ceased. EDF and AREVA have notified the regulators that they plan to resolve all remaining issues by December 2012. The Office for Nuclear Regulation and Environment Agency will not grant design acceptance until all issues raised in the Generic Design Assessment have been resolved.

3.10 The Office for Nuclear Regulation has recovered £47 million and the Environment Agency has recovered £5 million from Westinghouse, EDF and AREVA to cover costs they have incurred in completing the Generic Design Assessments of their reactor designs.

Planning



Source: National Audit Office

3.11 Developers of new nuclear power stations must obtain a Development Consent Order through the normal planning process. To reduce the cost and time taken to complete the planning process, which in the case of Sizewell B took six years, the Government introduced reforms through the Planning Act 2008. Under the new arrangements and following the transfer of responsibilities in April 2012 from the Infrastructure Planning Commission, nuclear operators submit their planning applications to the National Infrastructure Unit within the Planning Inspectorate.

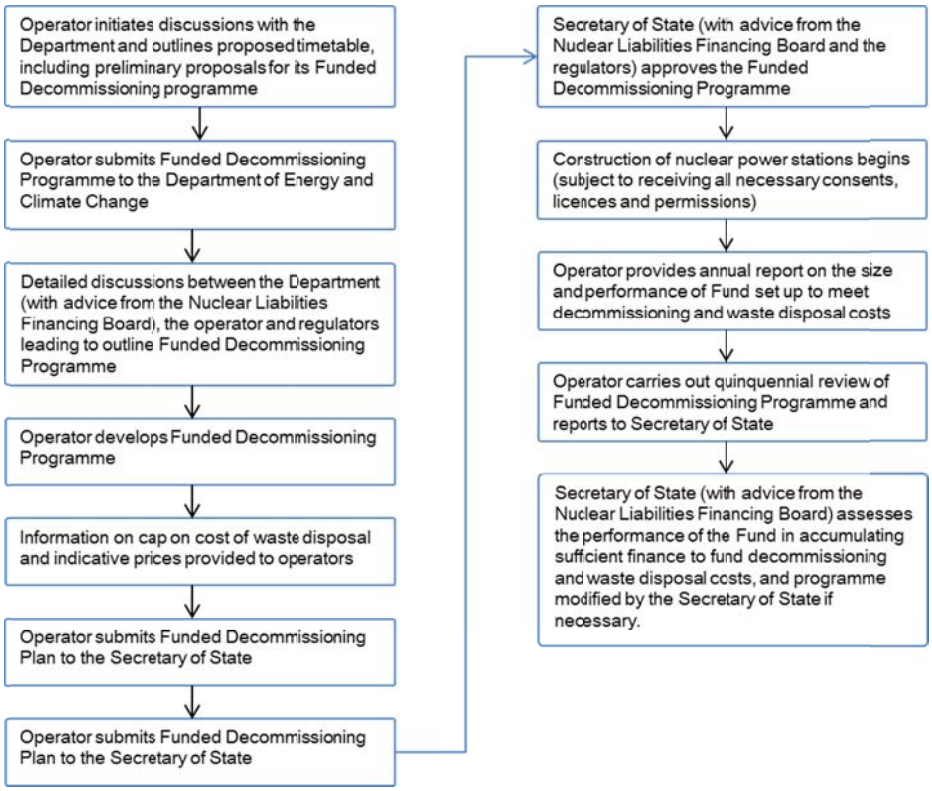
3.12 Before applying for a Development Consent Order, applicants must meet certain pre-application obligations that include consulting local communities, local authorities, other public bodies and landowners. Applicants must also prepare and consult on an Environmental Impact Assessment. The process and timetable for carrying out these pre-application requirements is determined by applicants.

3.13 The National Infrastructure Unit has 28 days to decide whether applications can proceed to the full examination phase, and six months to carry out a detailed examination, using the relevant National Planning Statements to assess the application. It then has a further three months to make a recommendation to the Secretary of State for Energy and Climate Change, who makes the final decision on whether to grant development consent.

3.14 EDF submitted an application in November 2011 to construct a nuclear power station with a total generating capacity of 3.26 gigawatts on land next to the existing power station at Hinkley. Permission to prepare the site at Hinkley was granted by West Somerset District Council in July 2011, but construction of the power station cannot start until planning consents, nuclear site licences and environmental permissions have been granted, which on current timetables will be in 2013. Other operators have yet to submit their applications.

3.15 Planning permission will also be required for the construction of grid infrastructure, and the Department expects the first planning applications to be submitted in the Summer of 2012. The sites for new power stations are all in areas with existing grid infrastructure, and where possible National Grid aims to re-use and upgrade existing connections. Hinkley Point has the best existing grid connection, which can support up to 2 gigawatts of generating capacity. The grid infrastructure in other areas will require more upgrading, particularly in the north of England where the existing infrastructure is only designed to handle generating capacity of 0.25 gigawatts. National Grid is consulting on plans to install new over ground grid connections to Hinkley Point and similar plans exist for the development of grid connections at Anglesey.

Decommissioning and waste disposal financing



Source: Department of Energy and Climate Change

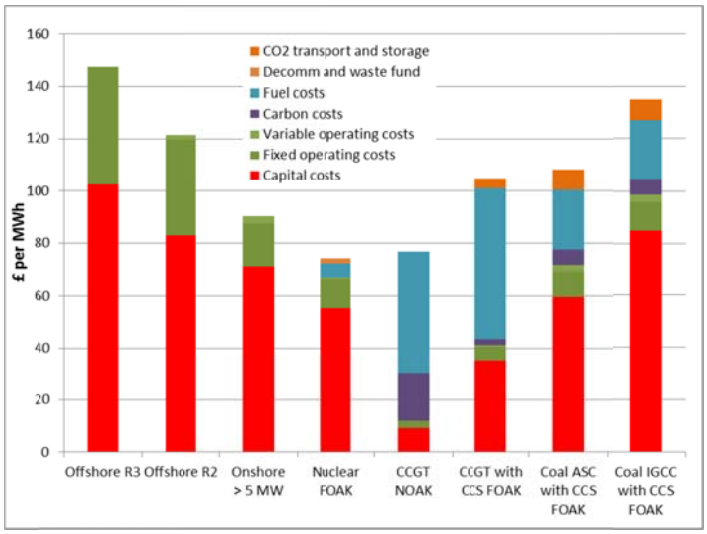
3.16 The Energy Act 2008 requires operators of new nuclear power stations to have Funded Decommissioning Programmes in place, approved by the Secretary of State, before construction of a new nuclear power station begins and to comply with this Programme thereafter. These Programmes have to set out the steps necessary to decommission the installation and manage and dispose of hazardous waste; an estimate of the cost of taking these steps; and details of any financial security to be provided to cover the costs of decommissioning and waste disposal. Failure to comply with the Programme is a criminal offence under section 57 of the Energy Act.

3.17 The Department has stated that it expects the financial security for covering the cost of decommissioning and waste disposal to take the form of assets held, managed and administered by an independent Fund. The Nuclear Liabilities Financing Assurance Board, which was established in 2009, is responsible for advising the Department on the suitability of Funded Decommissioning Programmes.

3.18 Where Funded Decommissioning Programmes are approved, the Department will enter into a contract with the operator that sets out the terms on which the Government will take title to and liability for the operator's spent fuel and intermediate level waste. The contract will also set out how the price that will be charged for this waste transfer will be determined.

3.19 The Department intends to initially set a cap on the price of waste disposal at a level where it will have a very high level of confidence that the actual cost to be incurred will not exceed the cap. Indicative figures published by the Department suggest that this would equate to a maximum liability for one power station that transfers waste for disposal in 2080 of around £370 million. The Government plans to defer setting the Waste Transfer Price for a 30 year period to allow cost uncertainty to be reduced.

Costs



	Flamanville, France	Okiluoto, Finland
Size	1630 MW	1600 MW
Original Budget	€3.3bn	€3bn
Current estimated cost	€6bn	€5.7bn
Application submitted	2005	2001
Start of Construction	2007	2005
Original completion date	2012	2009
Likely completion date	2016	2016

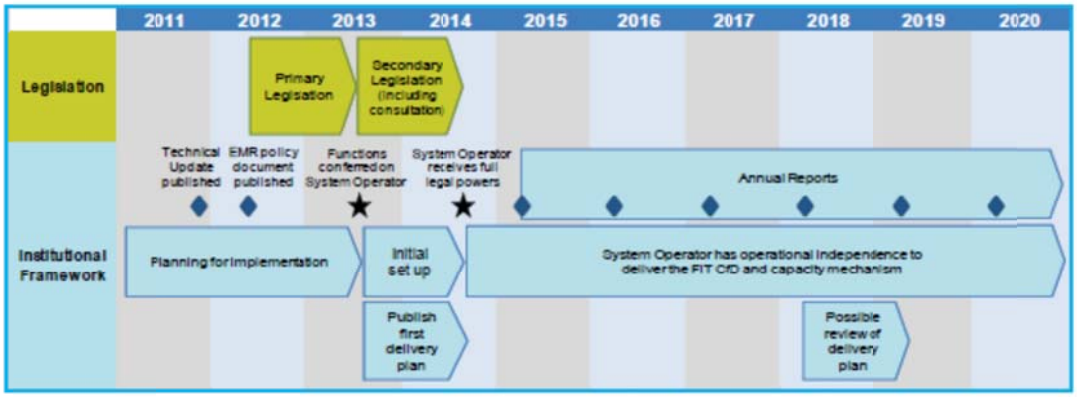
Source: National Audit Office, based on data published by the Department of Energy

3.20 The Department estimates that it will cost nuclear operators around £50 billion to build the 16 gigawatts of nuclear capacity that they plan to install in Britain. In 2011, the Department updated its research on the costs of different generating technologies, which cover capital, maintenance and fuel costs (where applicable) and the costs of carbon emissions from fossil fuel plants. These 'levelised' costs are estimated over the entire planned life of the generating plant, discounted to present values and expressed as a cost per megawatt hour. This enables the costs of different technologies to be compared. This cost data suggests that, excluding hydropower, nuclear power is the cheapest available generating technology with an overall cost of £74 per kilowatt hour.

3.21 These cost estimates depend on uncertain assumptions about the future price of fossil fuels over the next 50 years, construction timescales and likely capital costs. They are also based on applying the same discount rate across all technologies. For investments with a higher degree of risk, such as nuclear power stations, investors will require a higher rate of return on capital. If different costs of capital were used to reflect the degree of investment risk, the cost of nuclear power would be significantly higher.

3.22 Power stations using the type of reactors proposed for new power stations in Britain are under construction in other countries but none has been completed. The estimated cost of completing the new nuclear power station at Flamanville in France, which is using the pressurised water reactor design, has increased from €3.3 billion to €6 billion as a result of “structural and economic” reasons. The cost of constructing a new nuclear power station using the same generic design at Okiluoto in Finland has also increased, to €5.7 billion. Areva is also constructing two reactors using this design in China, and the first reactor is due to start operating in 2013. The other design that has been proposed for British nuclear power stations - the Westinghouse-designed AP1000 – has also experienced cost overruns, although construction is more advanced, with the first new reactor due to enter operation in China in 2013.

Market support



Source: Department of Energy and Climate Change

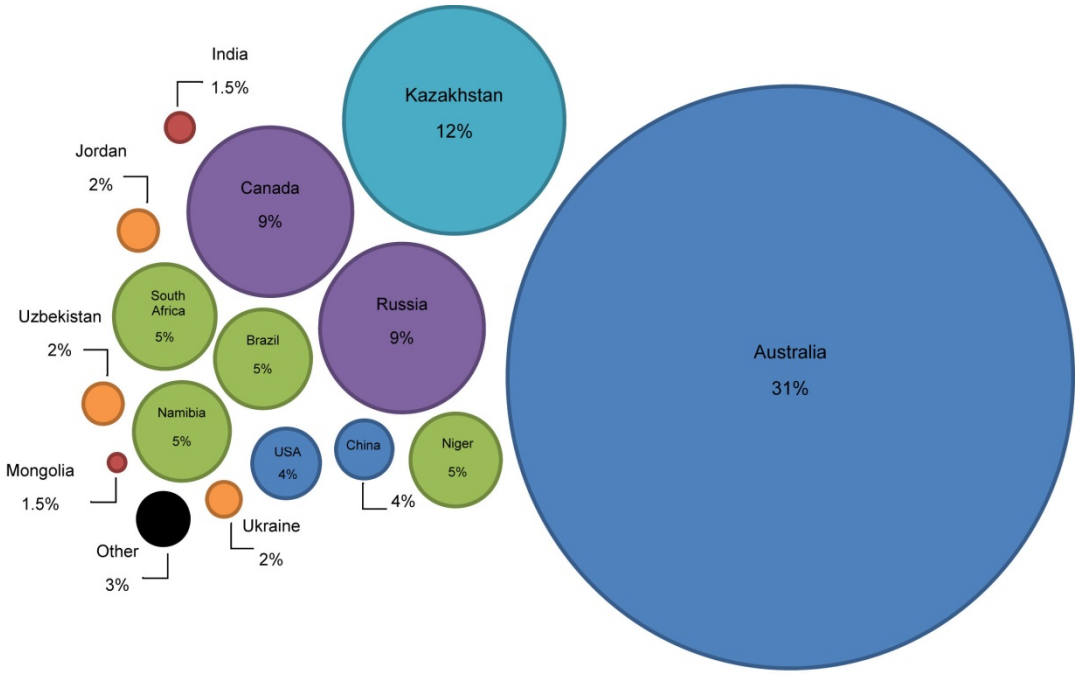
3.23 The Government has stated that there will be no public subsidy to help meet the costs of nuclear power. However, nuclear operators will benefit from measures to be put in place as part of proposed electricity market reforms to encourage investment in low-carbon generation. The main forms of direct market support that will be available to nuclear and other low carbon generators will be feed-in tariffs with contracts for difference and capacity payments. The cost of these measures will be shared across suppliers and ultimately borne by consumers. The EU Emissions Trading Scheme, the Emissions Performance Standard and the Carbon Price Floor, which increase the cost of fossil fuel generation, also make investment in low carbon generation relatively more attractive.

3.24 The feed-in tariff with contracts for difference will be a long-term contract between an electricity generator and a contractual counterparty. The contracts will ensure generators receive a guaranteed price (the strike price) for the electricity they generate for the duration of the contracts. The generator will receive payments under the contract when the market price for its electricity (the reference price) is below the strike price set out in the contract. When the market price is higher than the reference price generators will pay the difference to the counterparty. The Department estimates that higher revenue certainty will reduce nuclear operators' cost of finance and so reduce their hurdle rates, which is the minimum return on their investment that they need in order to invest in new power stations, from 12.7 per cent to 11.2 per cent.

3.25 Generators will alternatively be able to compete for capacity payments, which will provide generators with a payment for available capacity. Capacity providers will compete for contracts to supply a specified quantity of capacity and will receive payments for available capacity or penalties if it is not available.

3.26 The first contracts for difference and contracts to provide capacity will not be in place until 2014 according the Government's timetable. Before this, interim measures may be required to provide potential developers of new nuclear power stations with assurance as to what they can expect to receive through contracts for difference or capacity payments to enable them to make the investment commercial and to obtain the necessary finance.

Security of supply



Source: World Nuclear Association

3.27 Britain is wholly reliant on imported uranium for its civil nuclear operations. Around 97 per cent of known recoverable resources of uranium are held by 15 countries. Australia holds the largest reserves, but Kazakhstan is the largest producer of uranium, providing 33 per cent of world supply. In 2010, ten companies marketed 87 per cent of the world's uranium mine production. The three largest suppliers are the Canadian company Cameco, which provided 16 per cent of total production, the French company Areva, which also provided 16 per cent of production and KazAtomProm (a state-owned company based in Kazakhstan), which supplied 15 per cent.

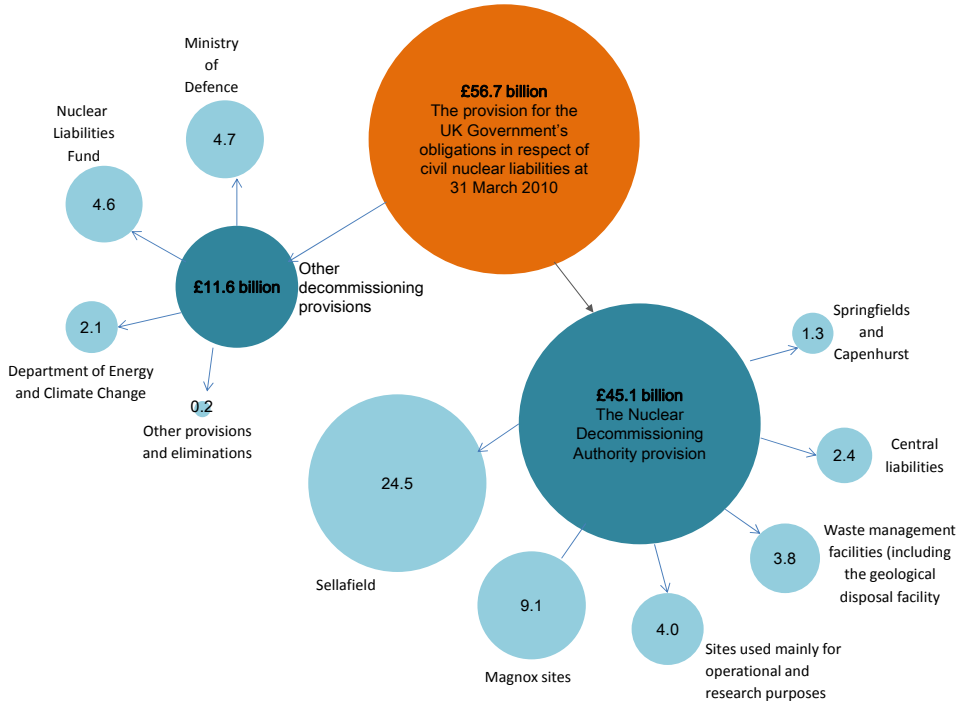
3.28 The Nuclear Energy Agency and the International Atomic Energy Agency estimate that there are known economic resources of uranium of some 3.5 million tonnes, which would last for 100 years at 2008 rates of consumption. However, global demand for uranium for electricity generation is projected to increase. The World Nuclear Association, whose members supply 90 per cent of world nuclear generation, estimates that as at March 2012 there were 372 gigawatts of nuclear power installed nuclear capacity worldwide. It estimated that there were some 60 nuclear power reactors under construction worldwide, including in China, South Korea and Russia, with a total capacity of 62 gigawatts and plans to install a further 181 gigawatts of capacity.

3.29 The Department considers that if existing resources were exhausted, the relatively small contribution of fuel costs to the overall cost of nuclear generation means that other, potentially more expensive, sources of uranium could be considered. Nuclear power station operators could alternatively consider reprocessing or, in the longer term, other reactor technologies.

Part four

Decommissioning and clean-up

Nuclear Decommissioning Liabilities as at 31 March 2010



4.1 The Whole of Government Accounts 2009-10, which were published in November 2011, showed that as at 31 March 2010, the Government's total provision for nuclear decommissioning was £56.7 billion. Some 80 per cent of this related to decommissioning civil nuclear sites owned by the Nuclear Decommissioning Authority, a non-departmental public body sponsored by the Department of Energy and Climate Change. Many of the older nuclear facilities that it owns were not developed with decommissioning in mind and contain nuclear materials from early civilian and military activity that were subject to poor management practice and neglect. As at 31 March 2011, the estimated cost of decommissioning the sites it owns, which will take more than a century to complete, was £49 billion (discounted to present values). The Nuclear Decommissioning Authority's spends 29 per cent of its total spending on decommissioning and clean-up.

4.2 The Department of Energy and Climate Change has a contractual responsibility to help British Energy meet the cost of its historic nuclear fuel liabilities up to 2029, with an estimated discounted cost as at 31 March 2011 of £2 billion.

4.3 The Nuclear Liabilities Fund is responsible for meeting the estimated £4 billion cost of decommissioning the eight operational nuclear power stations that are owned by EDF. It is a Scottish registered company holding investments with a market value of £8.6 billion as at 31 March 2011. The return on the fund's assets is below the 3 per cent discount factor used to estimate the £4 billion decommissioning liability. The Fund's investment policy, which is set by the Secretary of State for Energy and Climate Change, is to invest almost wholly in the National Loans Fund, which provides relatively low returns but reduces the Government's overall debt in the short-term.

The volume of radioactive waste in Britain

Level of waste	At 1 April 2010 (m^3)		Projected total including future arisings (m^3)	
High level waste				
Nuclear Decommissioning Authority – All held at Sellafield	1,620	1,620	1,020	1,020
Intermediate level waste				
Nuclear Decommissioning Authority	85,300		245,000	
Ministry of Defence	5,420		11,700	
EDF Energy	3,080		28,800	
UK Atomic Energy Authority	30		193	
GE Healthcare	428		728	
Other	98		100	
	94,300*	94,300	287,000*	287,000
Low level waste				
Nuclear Decommissioning Authority	61,500		4,210,000	
Ministry of Defence	2,360		52,200	
EDF Energy	743		128,000	
UK Atomic Energy Authority	600		6,570	
GE Healthcare	0		24,000	
Urenco	231		2,810	
Minor Producers – *as above*	568		7,500	
	66,000*	66,000	4,430,000*	4,430,000
Total		161,920		4,720,000*

NOTE

Totals do not sum due to rounding.

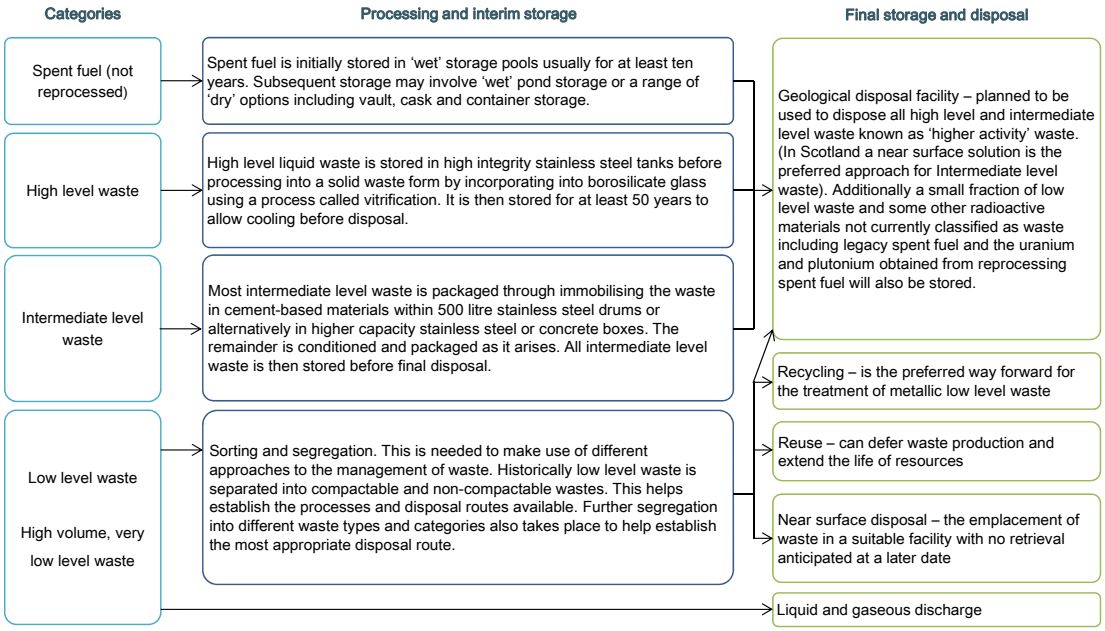
Source: Nuclear Decommissioning Authority

4.4 The latest available data show that there were 162,000 m^3 of radioactive waste located in Britain as at 1 April 2010, of which 92 per cent was held by the Nuclear Decommissioning Authority. The Nuclear Decommissioning Authority estimates that the total volume will increase to 4.7 million m^3 over the next few decades as a result of an increasing volume of radioactive materials in existing nuclear facilities being declared as waste as part of the decommissioning and site clean-up process.

4.5 High level waste generates intense levels of radioactivity and comprises liquids produced during reprocessing nuclear fuel and the glass that is created by "vitrifying" these liquids. This waste accounted for one per cent of the total volume of nuclear waste as at 1 April 2010 but contained 95 per cent of the radioactivity. The volume of high level waste is forecast to reduce as the vitrification process reduces its volume by a factor of 10. Intermediate level waste comprises material such as nuclear reactor components, fuel casings and graphite from reactor cores. Low level waste contains less than 0.01 per cent of the radioactivity. It includes building rubble, scrap metal soil, paper and plastics.

4.6 These figures make no provision for waste produced by new nuclear power stations. They also exclude spent nuclear fuels that could potentially be reused, such as the 115 tonnes of plutonium held at Sellafield and Dounreay. In December 2011, the Government announced that following a consultation on the management of plutonium, its preferred policy is to process the plutonium for reuse as a mixed oxide fuel rather than disposing of it as waste, but that further information is required before it can take a decision on whether to build a new mixed oxide fuel processing facility to replace the facility at Sellafield that was closed in August 2011 following several years of poor performance.

The management of radioactive waste



Source: National Audit Office

4.7 Low level waste is stored at a near-surface Low Level Waste Repository near Drigg in Cumbria.` A new vault with a 110,000 cubic metre capacity was completed at this site in 2010, which could be extended further to provide additional capacity. Through the use of an extended disposal area the repository could take all the low level waste in the UK waste inventory up to 2127, if very low level waste is diverted and multiple waste treatment routes are established.

4.8 There is currently no facility for the disposal of intermediate and high-level waste or spent fuel. The Government's policy for managing this waste is to package and immobilise it as soon as possible and to place it in interim surface storage. Packaged waste is currently being stored in interim stores which are designed to provide safe and secure storage for up to 100 years.

4.9 The Government's preferred approach to the long-term management of intermediate and high level waste is to dispose of it in a geological disposal facility. If new nuclear power stations are built in the UK, the Government considers that it is technically possible and desirable to dispose of both new and legacy waste in the same geological disposal facilities. The Scottish Government is committed to near surface, near site disposal of existing intermediate level waste to allow it be monitored and retrieved with minimal need for transport over large distances. Reflecting the type of waste that is held on sites in Scotland, Scottish Government policy does not encompass high level waste or spent fuel.

4.10 The Nuclear Decommissioning Authority is responsible for planning and implementing the geological disposal facility. It is currently undertaking preparatory studies to identify sites that are potentially suitable in geological terms. It plans to complete these preparatory studies in 2015. It will then undertake detailed surface-based investigations to assess the local geology. Construction is provisionally scheduled to start in 2025, with the emplacement of intermediate level waste potentially commencing in 2040 and high level waste in 2075, although these are only indicative dates. Work on permanently sealing the facility could potentially start in 2175.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