COMMUNITY OVERVIEW AND SCRUTINY COMMITTEE

Committee Report

Public

Date of Meeting:

26 February 2002

Title:	**ASPECTS OF "MANAGING RADIOACTIVE WASTE SAFELY"**
Report of:	**Town Clerk and Chief Executive**
Report reference:	**TC/43/02**

Summary:

This report aims to provide Members with a brief background to the Government's consultation document "Managing Radioactive Waste Safely". In particular, it highlights those aspects of the consultation upon which the Committee may wish to question the expert witness.

Recommendations:

1. Members consider the consultation document and supporting information and question the expert witness.
2. The Committee put its views to the Executive to inform their response to the Government's consultation document.

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1 INTRODUCTION

1. The Department for Environment, Food and Rural Affairs issued a consultation document "Managing Radioactive Waste Safely: Proposals for developing a policy for

managing solid radioactive waste in the UK" (Appendix 1 to this report) on September 12, 2001. The consultation period for this document ends on March 12, 2002.

2. This consultation begins a staged process that will end in 2007 with the selection of an option for the long-term management of radioactive waste and the passing of any necessary legislation. As such, this consultation document does not seek to define a final option for dealing with radioactive waste. Rather, the purpose of the consultation is to gather views on the Government's plans for the process by which the final policy should be decided upon. In brief, it is proposed that research and public debate be first used to determine the best option. Once the 'best option' has been chosen, further consultation will be undertaken on how that option should be implemented and, presumably, the siting of any radioactive waste facilities.

2 APPROACH TO THE CONSULTATION PAPER

2.1 Although Carlisle does not have a direct role in radioactive waste management, waste does routinely pass through the city on its way to Sellafield. Carlisle could also be affected by any serious incident at the Sellafield site. These facts will flavour the Council's response to the Government's consultation document but it is also intended that the Community Overview and Scrutiny Committee comment on some specific aspects of the consultation document from a more general perspective.

2.2 Given the limited time available in which to develop a response to the consultation document, it is proposed that the Committee focus on the following aspects: the process for the siting of any waste facility, the role of local authorities in the policy development process and the storage arrangements for radioactive waste at Sellafield.

3. PROCESS FOR SITING OF ANY WASTE FACILITY

1. Previous attempts to develop a policy for the disposal of radioactive waste have been unsuccessful. Perhaps the main reasons have been the failure to make a sound technical case and the difficulties of convincing a local community to accept a radioactive waste facility. The application to build an underground laboratory at Sellafield (with a view to ultimately building a deep underground depository for radioactive waste) was finally rejected in 1997 after a public inquiry. As such, the UK does not have a long-term policy for the management of the two most radioactive waste types, Intermediate Level Waste (ILW) and High Level Waste (HLW) (see pages 14-15 of the consultation document for further details).

2. The first part of the new process for policy development revolves around a national debate on radioactive waste policy (see Chapter 5, page 41). However, the success of any chosen option will ultimately rely upon a local population accepting the siting of a facility in their neighbourhood. Some research evidence and international experience shows that the earlier that local communities are involved in the process, the more likely it is to be successful. This raises questions about when to reveal a list of potential sites for a waste facility – until sites are identified, it is unlikely that many local communities will become involved in the debate.

3. The Government's green paper on planning (published in December 2001) also raises questions about the process for site selection. One of the main proposals in the green paper was to 'streamline' the planning procedures for 'major infrastructure projects'. At present, planning decisions about major projects (such as a runway or a radioactive waste facility) often go to a lengthy public inquiry. However, under the proposals, Parliament would be asked to approve a project in principle with only the detailed aspects of the project then being considered at a public inquiry. Some organisations have expressed concern that this amounts to a downgrading of the role of the public in

the planning process.

4. The consideration of the process for siting a waste facility throws up the following issues:

- At what point during the process should a list of potential sites be publicly identified (since this will provoke much greater interest from local communities that may be affected)?
- Should lists drawn up previously be made public (Nirex drew up both 'short' and 'long' lists in the 1980s)?
- Should local communities be given the power of veto over any proposals?
- Should local communities be offered compensation for hosting a facility?
- For both veto and compensation, at what scale should 'local' be defined – parish, district, county or regional level?
- What impact might the proposals in the Planning Green Paper have on the site selection process?

4. THE ROLE OF LOCAL AUTHORITIES

1. The document stresses the need for consultation and public involvement throughout the process. However, the role of local authorities is not made clear. The Committee may wish to explore what the role of local councils should be during the development of national policy and, ultimately, the selection of specific sites for radioactive waste facilities.

2. The Government has suggested that a new advisory body could be set up, to help guide the policy development process (See paragraphs 6.8-6.10, page 50). The role and membership of the body have not been fully defined and there is some debate as to whether any new body would provide general advice to Government or if it would be charged with delivering a set of final policy recommendations. The body could, however, form one of the main routes by which local authorities were given a greater input to, and control of, the process.

3. Once a list of possible sites has been developed, representatives of the local communities will need to be involved. The detailed question of 'how' has not been resolved. If the selection of policy and site are to be successful, local communities will need to feel a sense of 'ownership' of the process. It could be argued that local authorities should be involved at an early a stage as is practicable since they are community leaders and often have established mechanisms to gather public views (e.g. Carlisle's Citizens' Panel).

4. The following issues emerge from the consultation document for local authorities to consider:

- What should be the role of local authorities in developing national policy in this area?
- Should local authorities be given representation on the 'independent body' that will be set up to oversee the policy process? Should the representatives be from those local authorities already identified as likely to host a radioactive facility?

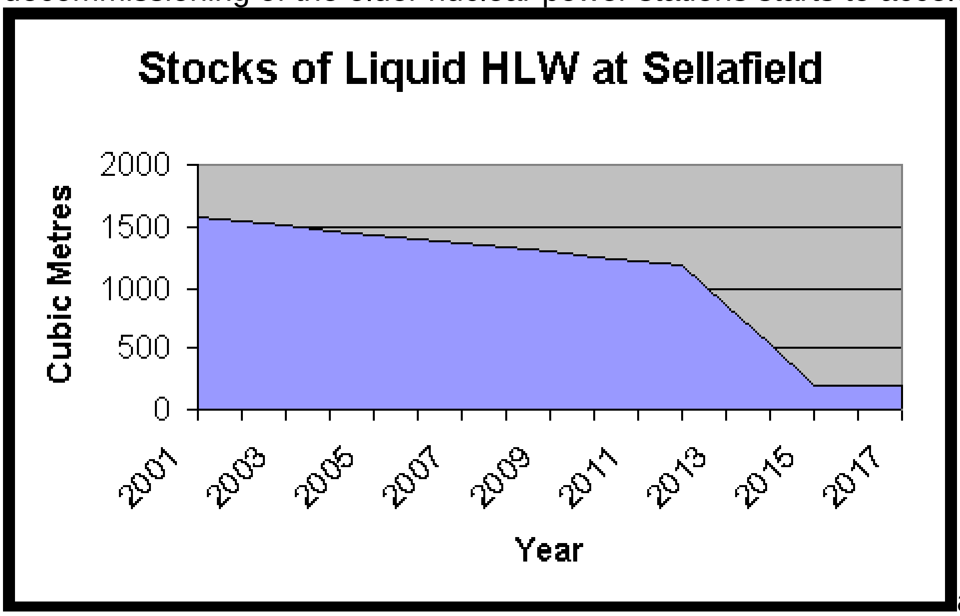
- What should be the role of local authorities in the site selection process?
- To what extent could the Citizens' Panel be used to provide feedback on the Government's plans?
- How should Carlisle City Council's consideration of this matter relate to Cumbria County Council's input?

5 STORAGE ARRANGEMENTS

1. In addition to the two areas outlined above, the events of September 11 raise the issue of storage arrangements. The Sellafield site forms one of the largest stores for radioactive waste in Europe. Given the long timescale for deciding upon a final option for dealing with radioactive waste (7 years to decide on the policy, probably another 10-20 years before any facility would be operational), the storage conditions on the site are of paramount importance. However, the consultation document does not consider storage as a topic for discussion, merely assuring that the waste is being "safely stored" (see paragraph 7.8, page 57).

2. The two most radioactive types of waste are Intermediate Level Waste (ILW, of which there is around 71,000 cubic metres stored in the UK, mostly at Sellafield) and High Level Waste (HLW, of which there is 1800 cubic metres stored at Sellafield). Although there is no final disposal policy in place for ILW or HLW, it is policy that the raw wastes should be 'conditioned' or made safer. However, there is a backlog in the conditioning process - particularly the so-called 'legacy wastes' which were created from the 1950s onwards by both the civil and defence nuclear industries. Much of this waste is stored in buildings which were constructed more than 30 years ago.

3. In 1998, just 15% of the ILW and 13% of the HLW stored at Sellafield had been conditioned. As reprocessing of spent fuel continues at Sellafield and decommissioning of the older nuclear power stations starts to accelerate, large



amounts of ILW and HLW will be created (See page 24 for details).

4. Relatively large quantities of liquid High Level Waste (HLW) are currently stored at Sellafield in surface tanks, which need constant stirring and cooling. Although this waste is gradually being conditioned and vitrified (turned into glass), there have been many problems with the vitrification process and these appear to be largely unresolved. Even under the current plans, there will remain large quantities of liquid HLW (more than 1000 cubic metres) at Sellafield until 2015 (see graph above). Members are referred to Appendices 2 and 3 'Sellafield shuts plants as N-waste builds up' (Guardian Website, 22 September 2001), and a Press Release from Cumbrians

Opposed to a Radioactive Environment (21 September 2001).

5. Following on from the events of September 11, there has been some research showing the potential impact of a plane crashing directly into the site. There is particular concern about the vulnerability of the tanks of liquid HLW. The Committee is referred to Appendices 4,5 and 6: ‘Airliner Crash on Nuclear Facilities: The Sellafield Case’, ‘Sellafield terror attack warning’ (*The Observer*, 16 December 2001), and ‘Sellafield terror threat warning’ (BBC News Website, 11 January 2002).

6. Key issues in respect of waste storage include:

- What is the risk of a terrorist attack at Sellafield? In the event of an attack, what would be the likely scale of impact on the surrounding area?
- How realistic is the plan to reduce the stocks of liquid High Level Waste at Sellafield? Could it be accelerated and, if so, how?
- What would be the effect on waste arisings of ceasing to reprocess fuel at Sellafield?
- Leaving aside the risk of terrorist attack, how safely is the waste currently being stored? Could the process of conditioning the Intermediate Level Waste be accelerated?

6 EXPERT WITNESS

6.1 At the meeting, the Committee will have an opportunity to question Dr Martin Courtis OBE about the issues outlined above. Dr Courtis is a consultant in the field of radioactive waste management and a member of the Government’s independent advisory body, the Radioactive Waste Management Advisory Committee (RWMAC).

Peter Stybelski

Town Clerk and Chief Executive

APPENDIX 1

Department of the Environment

Cynulliad Cenedlaethol Cymru
The National Assembly for Wales

SCOTTISH EXECUTIVE

DEFRA
Department for
Environment,
Food & Rural Affairs

Managing Radioactive Waste Safely

Proposals for developing a policy for managing solid radioactive waste in the UK

Department of the Environment

Cynulliad Cenedlaethol Cymru
The National Assembly for Wales

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Proposals for developing a policy for managing solid radioactive waste in the UK

September 2001

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CONTENTS

APPENDIX 3

APPENDIX 4

APPENDIX 5

APPENDIX 6

Executive Summary

1. More than 10,000 tonnes of radioactive waste are safely stored in the UK, but await a decision on their long-term future. This will increase to 250,000 tonnes when nuclear material currently in use is converted into solid waste. Even if no new nuclear power plants are built and reprocessing of spent nuclear fuel ends when existing plants reach the end of their working lives, about another 250,000 tonnes of waste will arise during the clean-up of those plants over the next century. Most of this waste results from the work of Government agencies or publicly owned companies since the 1940s. Some of the substances involved will be radioactive and potentially dangerous for hundreds of thousands of years.

2. There are much larger amounts of low-level (less radioactive) waste. Currently, these are disposed of at a special surface repository in Cumbria. But again, much larger amounts will arise as existing nuclear facilities are cleaned up.

3. We must decide how to manage this waste in the long term. Implementing that decision will take decades. So now is the time to start planning for our future.

4. In this paper, the UK Government and the Devolved Administrations for Scotland, Wales and Northern Ireland are launching a national debate which will lead up to that decision, and beyond it. The aim is to develop, and implement, a UK nuclear waste management programme which inspires public support and confidence. To do this, we propose a major programme of research and public discussion, using many techniques – some traditional, some relatively new – to stimulate informed discussion, and to involve as many people and groups as possible.

5. We want to inspire public confidence in the decisions and the way in which they are implemented. To do that, we have to demonstrate that all options are considered; that choices between them are made in a clear and logical way; that people's values and concerns are fully reflected in this process; and that information we provide is clear, accurate, unbiased and complete.

6. So we propose to set up a strong, independent and authoritative body to advise us on what information there is, what further information is needed, and when enough information has been gathered for decisions to be made on how the UK's radioactive waste should be managed. For example, should it be put in an underground repository? or stored, until we know more about its risks and better ways of dealing with it? or some other option or combination? After that, we can start a debate on where in the UK we should keep this waste in the long term.

7. The paper sets out a proposed programme of action for reaching decisions. This has five stages:

Stage one	This consultation on the proposed programme; considering responses; planning the next stage	2001–2002
Stage two	Research and public debate, to examine the different options and recommend the best option (or combination)	2002–2004

Stage three	Further consultation seeking public views on the proposed option	2005
Stage four	Announcement on the chosen option, seeking public views on how this should be implemented	2006
Stage five	Legislation, if needed	2007

This is only a rough guide. The shape and speed of the programme will depend on many factors, including public comments on this consultation paper. We must press ahead as quickly as we can. But we must also get the decisions right, and ensure that the strategy wins public confidence.

8. There are some radioactive materials – such as plutonium, or spent nuclear fuel – which are not currently classified as waste. But if at some point it were decided that there was no further use for some or all of these materials, we would need to consider how to handle them as part of a waste management strategy. We think that these issues should be addressed as part of this consultation.

9. So the consultation paper explains what radioactive waste there is in the UK, what the problems are and what decisions have to be taken; describes some options and what some other countries are doing; sets out proposals for reaching decisions; and invites your views.

CHAPTER 1

Introduction

Summary

1.1 This chapter sets out the historic background to radioactive waste management in the UK. It explains the purpose of this consultation paper and gives details of how you can let us have your comments.

Background

1.2 In 1982 the Nuclear Industry Radioactive Waste Management Executive (Nirex) was established to develop a long-term solution for the disposal of solid intermediate level radioactive waste. In 1991, after several years of site evaluation and public debate, Nirex selected Sellafield, in Cumbria, as its preferred option for investigations into the site of a deep repository for the disposal of radioactive waste. A year later, Nirex announced that it wished to build an underground rock laboratory (Rock Characterisation Facility or RCF) to investigate the geology and groundwater regimes of the proposed repository in more detail.

1.3 In March 1997 the then Secretary of State for the Environment decided not to give Nirex planning permission for the RCF. This decision called into question whether at that time an underground repository for the disposal of radioactive wastes could be scientifically justified or publicly acceptable. This led to a completely new look at radioactive waste management policy in the UK.

1.4 The first stage of this review was led by the House of Lords Select Committee on Science and Technology. It conducted an enquiry into "The Management of Nuclear Waste" from November 1997 till March 1999. The Committee's report[1] has provided an important framework for the Government's thinking to develop – particularly on the issue of public acceptability.

1.5 The Government made its initial response to the Select Committee's recommendations in October 1999[2]. It said that it proposed to publish a detailed and wide-ranging consultation document in 2000. This has taken much longer than planned. But here it is.

Aim of the Consultation

1.6 The Government and Devolved Administrations aim to start the process that ultimately leads to the implementation of a radioactive waste management policy which earns broad public support across the UK.

1 House of Lords Session 1998-99 Third Report of the Select Committee on Science and Technology. "Management of Nuclear Waste" (March 1999)

2 DETR "The UK Government Response to the House of Lords Select Committee Report on the Management of Nuclear Waste" (October 1999)

1.7 Radioactive wastes have been accumulating for decades. We have to get on and decide what to do with them in the long term. We recognise that we should not rush the process, but take the time required to get it right and win public confidence. Wastes can continue to be stored safely in the medium term using current technology. So the timetable for deciding and implementing policy should be driven by the need to develop a clear understanding of the safety and environmental issues associated with each potential waste management option. We shall be guided by key principles, such as the need for an open and fair assessment of options and to achieve sustainable development. Some are mentioned above; more details are given in Appendix 5.

1.8 This consultation therefore begins a debate on:

- The size and scale of the problem (Chapter 2, 3 and 4);
- How the views of the public will contribute to the policy-making process (Chapter 5);
- Any organisational changes needed to ensure that a sound policy is chosen and implemented (Chapter 6); and
- The programme for the development and implementation of policy (Chapter7).

1.9 What this consultation does NOT seek to do is:

- Endorse a long-term management option;
- Dismiss any management options, (except where they have already been ruled out by international agreements or treaties) or
- Identify organisational changes specific to any long-term management options.

1.10 The Government's independent Radioactive Waste Management Advisory Committee (RWMAC) has put forward its own recommendations on how the Government should manage this process. There are close similarities between its views and Ministers' position set out in paragraph 1.7. It also makes many detailed suggestions which need to be considered as part of the policy process. You may like to read these. The Committee's recommendations were published on 12 September 2001 and you can get a copy from DEFRA Publications, Admail 6000, London SW1A 2XX (08459 556000), the DEFRA website at www.defra.gov.uk/rwmac.index.htm or the Scottish Executive website at www.scotland.gov.uk.

DISCHARGES

1.11 This consultation paper is concerned only with solid radioactive waste. In June 2000 the UK Government and the Devolved Administrations published a consultation paper "UK Strategy for Radioactive Discharges 2001-2020"[3] which describes how the UK will implement the agreements reached at the 1998 Ministerial meeting of the OSPAR Commission for reducing discharges of radioactive substances. Consultation responses are being considered and the Government aims to publish a final version of the strategy

3 Department of the Environment, Transport and the Regions (DETR, now DEFRA) "UK Strategy for Radioactive Discharges 2001-2020 Consultation Document" (June 2000)

around the end of 2001. The Government also published for consultation in November 2000[4], draft guidance to the Environment Agency on the setting of radioactive discharge limits. After considering responses, the Government aims to produce a final version of the guidance at the beginning of 2002. The Scottish Executive will consult on statutory guidance to the Scottish Environment Protection Agency, SEPA. The strategy and the guidance will form a clear policy base for future reviews of discharge authorisations by the regulators, and for strategic planning by the waste producers.

Devolution

1.12 These proposals are published jointly by the UK Government and the Devolved Administrations. Where possible these are referred to simply as "we". Appendix 6 gives more detail on how devolution affects radioactive waste management.

YOUR COMMENTS ON THIS PAPER

1.13 We would welcome your views on this paper. Please be sure that you get them to us by [**12 March 2002**]. You can write, fax, or e-mail to:

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1.14 If you live in Scotland, Wales or Northern Ireland you can write to:

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4 Department of the Environment, Transport and the Regions (DETR, now DEFRA) 'Statutory Guidance on the regulation of radioactive discharges in the environment from nuclear licensed sites'

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1.15 We may publish the responses, possibly putting them in the Libraries of the Houses of Parliament, the Scottish Parliament, the National Assembly for Wales, Northern Ireland Assembly or in the Departments' own Libraries, unless you specifically ask us to treat your response as confidential. Confidential responses may nevertheless be included in any statistical summary of comments received and views expressed.

1.16 A copy of this document will also be made available on the internet at:

www.defra.gov.uk/environment/index.htm

CHAPTER 2

How have radioactive wastes been managed up to now?

Summary

2.1 This chapter describes what radioactive waste is, how it is categorised in the UK and how much exists. It also explains where the wastes come from, and how they are currently managed.

What is Radioactive Waste?

2.2 Waste contaminated by, or incorporating radioactivity above threshold levels defined in legislation, is known as radioactive waste. Radioactivity is the spontaneous disintegration of radionuclides (unstable atomic nuclei, both natural and man made) in a process known as radioactive decay. During radioactive decay energetic particles and electromagnetic radiation are emitted which are termed ionising radiation. As its name implies, ionising radiation causes ionisation in material through which it passes. Within the human body it can cause immediate damage to living tissue if doses are high, and can either directly or indirectly increase the risk of hereditary defects and malignant disease.

2.3 As a result of radioactive decay, a radionuclide is transformed into another type of atomic nucleus. The rate at which this occurs is known as the activity and is proportional to the amount of the radionuclide present. As time passes the activity decreases. The half-life is the time taken for half of any given amount of radionuclide to decay. For every radioactive nuclide, the half-life is unique and unchangeable. Some of the radioactive waste which needs to be managed in the UK contains radionuclides with half-lives of hundreds of thousands of years, and therefore needs to be segregated from the environment and human contact during the lifetimes of many generations to come.

2.4 The UK regularly publishes a Radioactive Waste Inventory[5], which shows the latest record of information on the sources, quantities and properties of civil and military radioactive wastes in the UK. Copies of the 1998 Inventory and a summary booklet are available from Nirex or DEFRA. An update of the Inventory for 2001 will be available in 2002.

How has Radioactive Waste been treated up to now?

2.5 The treatment and handling of radioactive wastes has been determined by the actual characteristics of the waste. However, for management purposes, rather than for any regulatory need, radioactive waste is divided into four categories according to its heat generating capacity and activity content.

5 The latest version is "Radioactive Wastes in the UK" DETR and Nirex (July 1999)

Very low level wastes (VLLW)

Wastes which can be disposed of with ordinary refuse, each 0.1 cubic metre (m^3) of material containing less than 400 kBq (kilobecquerels) of beta/gamma activity or single items containing less than 40 kBq

Low level wastes (LLW)

Containing radioactive materials other than those suitable for disposal with ordinary refuse, but not exceeding 4 GBq/te (gigabecquerels) of alpha or 12 GBq/te of beta/gamma activity – that is, wastes which can be accepted for authorised disposal at Drigg, Dounreay or other landfill sites by controlled burial

Intermediate level wastes (ILW)

Wastes with radioactivity levels exceeding the upper boundaries for LLW, but which do not need heating to be taken into account in the design of storage or disposal facilities

High level wastes (HLW)

Wastes in which the temperature may rise significantly as a result of their radioactivity, so this factor has to be taken into account in designing storage or disposal facilities

VERY LOW LEVEL WASTE

2.6 Very low-level waste (VLLW) covers wastes with very low concentrations of radioactivity. It arises from a variety of sources, including hospitals and non-nuclear industry. Because VLLW contains little total radioactivity, it has been safely treated as it has arisen by various means, such as disposal with domestic refuse directly at landfill sites or indirectly after incineration.

LOW LEVEL WASTE

2.7 Solid low-level waste (LLW) includes metals, soil, building rubble and organic materials, which arise principally as lightly contaminated miscellaneous scrap. Metals are mostly in the form of redundant equipment. Organic materials are mainly in the form of paper towels, clothing and laboratory equipment which have been used in areas where radioactive materials are used – such as hospitals, research establishments and industry.

2.8 Since the 1950s around 1,000,000m^3 of LLW has been safely disposed of, mainly at the shallow burial site at Drigg, Cumbria and to a lesser extent at Dounreay, Caithness. The 1998 Inventory indicates that there were 8,000m^3 of LLW in storage, about half of this was in temporary storage awaiting disposal. The rest is either unsuitable for disposal, or is being stored pending future treatment to make it passively safe. LLW from Dounreay in Caithness was disposed of in waste pits excavated in the surface rock. LLW scheduled for Drigg is now mostly subject to high force compaction and then placed in metal containers, of about 15m^3 capacity, prior to grouting with cement and placement inside a concrete-lined vault. British Nuclear Fuels plc (BNFL) operate the Drigg site as a commercial venture. In addition to the LLW generated by BNFL, Drigg provides a UK-wide disposal service to a spectrum of customers including hospitals and universities.

INTERMEDIATE LEVEL WASTE

2.9 Intermediate level waste (ILW) arises mainly from the reprocessing of spent fuel, and from general operations and maintenance of radioactive plant. The major components of ILW are metals and organic materials, with smaller quantities of cement, graphite, glass and ceramics. Over the period 1949 to 1982 73,530 tonnes of low and intermediate waste has been disposed of by the UK to the North East Atlantic. Since 1982 ILW which would have been disposed to sea has been stockpiled. In addition some arisings from the late 1940s onwards have been stored on sites. The 1998 Inventory reveals that there were then 71,000m^3 of ILW in storage, 8,500m^3 of which had been treated to achieve passive safety by forming stable packages for long term management. Be it storage or disposal, this treatment is called **conditioning**. Stainless steel drums of 500 litre capacity are the main containers used. In order to avoid the additional radiological dose to workers and the very high costs that would be associated with re-packaging, conditioning is carried out in such a way as to anticipate the requirements for the future long-term management of the wastes. ILW, be it in raw or conditioned form, is mainly stored in shielded buildings, vaults or silos, mostly at the site where it arises. The majority originates at Sellafield.

2.10 Proposals for the conditioning of wastes are put to Nirex which assesses them against the safety of storing, transporting, handling and possible disposing of the wastes. Following such assessments, Nirex provides formal advice to guide waste producer plans and future development. When satisfied that the proposals are consistent with Nirex standards and specifications, Nirex packaging principles and the Nirex phased disposal concept, (in particular that the packages would be safe in an underground facility for protracted periods both before and after any backfilling and sealing), Nirex will provide endorsement in the form of a Letter of Comfort. This is not an automatic outcome from the submission of waste packaging proposals, as Nirex is sometimes unable to issue a Letter of Comfort.

2.11 As no final management strategy for ILW exists, one of the aims of this consultation paper is to set out the process through which an ILW management policy capable of commanding widespread public support will be chosen.

HIGH LEVEL WASTE

2.12 High Level Waste (HLW) is a heat-generating waste that has accumulated since the early 1950s at Sellafield and Dounreay as the concentrated liquid nitric acid product from the reprocessing of spent nuclear fuel. HLW comprises only about 2% of the UK's total volume of stored radioactive waste, but about 90% of its radioactive content. HLW storage facilities have cooling systems to dissipate the heat that the waste generates, and massive concrete shielding to protect the operators. The Health and Safety Executive (HSE) reported on 18 February 2000 that there were 1300m^3 of liquid HLW stored in water-cooled tanks at Sellafield. The equivalent of a further 900m^3 of liquid HLW had already been converted at Sellafield into a solid and stable form by immobilising it in glass (vitrification) within stainless steel canisters of about 140 litre capacity. There is a smaller quantity of less active HLW, 230m^3, still in liquid form at Dounreay. Current Government policy is that vitrified HLW should be stored for at least 50 years to allow the heat to decline so as to make long-term management less complex.

2.13 As with ILW, there is currently no final management strategy for HLW. Therefore, and as the issues associated with the development of a management strategy for both sets of wastes are similar, this paper also sets out how a management strategy for HLW, which commands widespread public support, will be chosen.

Box 1: EU Classification System for Radioactive Waste

2.14 At the present time the classification systems for radioactive waste in use across the European Union vary widely in approach and application. Some are used purely for communication purposes, while most are dictated by the available management routes or by activity concentration.

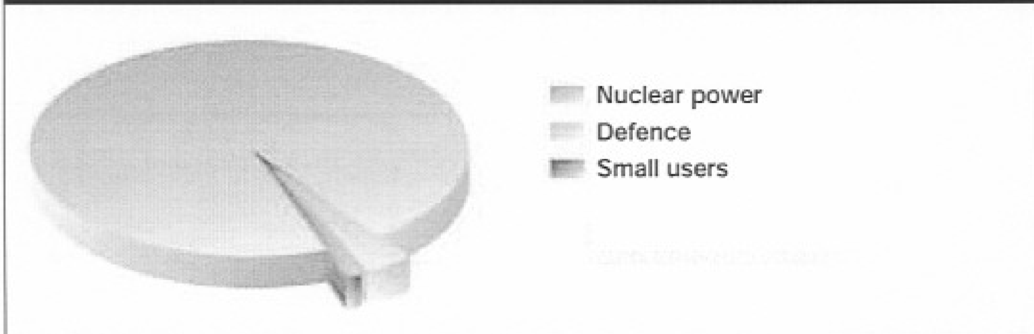
2.15 An EU Classification system has been proposed (to be used in conjunction with National systems, not replace them), following a meeting of EU representatives in January 1998 in Brussels. The system is based on the International Atomic Energy Authority (IAEA) classification scheme, with some modifications. It is to be used for transmitting data to the Commission for the compilation of a European waste inventory.

2.16 The main difference from the UK classification is the addition of categories for transitional waste that will decay within a short period of storage to unrestricted clearance levels, and the division of our ILW and LLW classifications into short-lived and long-lived LILW (Low and Intermediate Level Waste). This system would, theoretically, have the advantage of making it easier to identify appropriate management routes. However, although it should be possible to construct and operate a system which made allowance for reductions in radioactivity over time, most UK wastes contain a mixture of radionuclides of different half-lives which makes the operation of such a system more problematic. Additionally, the dose resulting from contact with radionuclides is not related to their half-life. The toxicity of radionuclides of similar half-lives are not necessarily the same. Therefore, the management of wastes is determined by the actual characteristics of the waste rather than by its classification.

2.17 ***Views are invited on the principle of segregating UK waste types by half-lives.***

What has created the stockpile of wastes?

All Radioactive Wastes (by volume)



NUCLEAR POWER

2.18 Nuclear power has been seen by successive Governments as a means of diversifying the supply of energy and as a potential export earner, and from the start of the civil programme in 1962 until 1996 has been wholly Government owned . The nuclear power sector has produced wastes from the enrichment of uranium, the fabrication of nuclear fuel, reactor operations (23% of the total UK volume – see also para 2.24), spent fuel reprocessing (63%) and related research and development activities. The large majority of the radioactivity in the UK's radioactive waste comes from the nuclear power sector. Most of the waste has been from the operation of the reactors but the Magnox power reactors at Hunterston, Berkeley and Trawsfnydd are in the process of decommissioning. Similarly nuclear facilities at Culcheth, Winfrith and Harwell have been dismantled. Much of the current waste production is from spent fuel reprocessing and waste management operations at Sellafield in Cumbria, particularly as a result of the disproportionate amount of ILW resulting from the first generation, Magnox programme, compared with more modern reactors.

Box 2: Nuclear Electricity Generation

2.19 Nuclear power currently contributes about 23% of the UK's electricity supply and plays an important role in helping the UK to meet its climate change targets. Current output is provided by two companies: British Energy plc and BNFL. British Energy owns eight nuclear stations, two of them in Scotland meeting over half of Scottish electricity demand, while BNFL owns and operates seven Magnox stations in England and Wales, and one in Scotland.

2.20 Carbon dioxide emissions from nuclear power generation are negligible and, in the absence of nuclear generation, UK emissions of carbon dioxide in 1998 would have been some 12 to 24 million tonnes of carbon higher, depending on the mix of generation used to replace it. The Government believes that existing nuclear power stations should continue to contribute to the electricity supply and to the reduction of emissions as long as they can do so to the high safety and environmental standards that are currently observed.

2.21 Nuclear output is likely to begin to decline, however, from around 2005 onwards, as the older stations begin to close. It is possible that two thirds of existing nuclear capacity could close by around 2012, although the probability is that life extensions will increase the amount available in that date and beyond. Electricity generation is then likely to become more carbon-intensive unless other low or zero carbon energy sources, particularly a strong renewables industry, can be developed.

2.22 As with other forms of electricity generation in the UK it is for generators to bring forward proposals for new plant. There are currently no such proposals for new nuclear power stations in the UK, largely due to nuclear's current inability to compete on cost grounds with other types of generation. Nuclear's future role will depend on its costs compared to other generation options, and securing public confidence about issues such as safety and the environment. For example, issues related to waste management would need to be addressed. The Government has begun a review of its future energy strategy. Among other things, this is looking at current or potential energy sources including nuclear.

2.23 Internationally, industry research and development is focussing on improving the economics of nuclear fission generation in parallel with ensuring that designs meet the very stringent public and regulatory requirements on safety, waste, and proliferation resistance in the context of growing awareness of climate change and sustainable development.

Defence

2.24 Defence wastes are those wastes that have been generated by Ministry of Defence (MOD) service and civilian establishments or companies that have undertaken work on behalf of the Ministry of Defence or its predecessors. These wastes have been mainly produced as a consequence of successive Governments' acceptance of the need for a nuclear deterrent. Between 3 – 10% of total UK wastes by volume are due to the military programme.

2.25 Wastes mainly originate from the nuclear weapons and submarine propulsion programmes. Radium wastes continue to arise from the remediation of the many sites where radium was historically used as a means of luminising dials and compasses. Smaller quantities of wastes continue to arise from the general use of radioactive materials within the armed forces and the Defence Evaluation Research Agency establishments.

2.26 Ministry of Defence policy on the management of its wastes stems from national policy as defined in the previous UK Government's 1995 White Paper "Review of Radioactive Waste Management Policy, final conclusions. Cm2919". Companies undertaking work on behalf of the Ministry of Defence are subject to civil regulation. Ministry of Defence sites are also subject to civil regulation except for the application of the Radioactive Substances Act 1993 and licensing under the Nuclear Licensing Act 1965.

2.27 Where legislation does not apply to the Ministry of Defence it is Ministry of Defence policy to ensure where practicable standards are as least as good as those required by legislation. It is also MOD policy at regular intervals to invite the Government's independent advisors, the RWMAC, publicly to review radioactive waste management practices at Ministry of Defence sites and those of its contractors.

2.28 The Ministry of Defence has made considerable progress in adopting civil regulation for defence sites, e.g. through the privatisation of dockyards and the management of the Atomic Weapons Establishments. In the light of these advances, the Government agrees in principle that, in order to increase public confidence, Ministry of Defence radioactive wastes should be brought under the civilian regulatory regime, provided that issues of national security, the operational effectiveness of the armed services and cost can be resolved.

Small Users

2.29 A 'small user' is the term given to organisations that produce radioactive wastes, but do not have sites licensed under the Nuclear Installations Act 1965. Small users include hospitals, universities, research laboratories, the off-shore oil and gas industry and some non-nuclear industries. There are approximately 5,600 small users on civil unlicensed sites in England and Wales, about 900 in Scotland and 150 in Northern Ireland.

2.30 Small users handle a wide range of radioactive materials, resulting in a variety of wastes, particularly in hospitals. These include 'washings' produced from laundry treatment of contaminated protective overalls and linen, and solid disposable items such as sources (see Box 3 for explanation), swabs, vials, syringes, gloves and dressings. There are also contaminated solid and liquid biological samples.

2.31 The volumes of LLW and VLLW produced by small users, other than the oil and gas industry, are small (100m^3 of LLW in 1999), and even smaller amounts of ILW are created. Current management policy allows solid LLW and VLLW and organic liquids to be burnt in incinerators. Alternatively, some types of LLW and VLLW can be disposed of in ordinary waste landfill sites, and LLW can be disposed of at the BNFL facility at Drigg. Low activity liquid LLW wastes that are not incinerated may be authorised for disposal to the sewerage system. Solid ILW goes into storage pending a final management route. Disposals of radioactive wastes are regulated under the Radioactive Substances Act 1993 by the Environment Agency, in England and Wales, the Scottish Environment Protection Agency (SEPA), in Scotland, and the Industrial Pollution and Radiochemical Inspectorate (IPRI), part of the Environment and Heritage Service within the Department of Environment, Northern Ireland. Some disposals of small amounts of radionuclides are allowed, with prior authorisation, under the Hospitals and Schools Exemption Orders.

2.32 During the routine extraction of oil and gas, quantities of water and solids are also removed from the sub-seabed reservoir. These materials may contain naturally occurring radioactive materials (NORM) which can accumulate on internal surfaces of process plant. The deposition of NORM increases if seawater, which is injected into rock to enhance oil flow, mixes with the other fluids. Radon gas follows the gas streams and subsequently deposits solid radioactive decay products. The deposited NORM can occur as a hard scale of low specific activity on the surface of pipework, valves, pumps and vessels; or as sludge contaminated with hydrocarbons in oil separators and oily water treatment plants; or as a sand/sludge uncontaminated by hydrocarbons.

2.33 Many of the oil and gas industry sludges are exempt from authorisation under the Radioactive Substances Act 1993 because of their low activity levels. But some are of higher activity and there are currently a very limited number of disposal routes open for this waste. Limited quantities of waste are authorised for discharge to the sea. An alternative route is disposal as solid waste to Drigg. However, the anticipated large future arisings from the oil industry are far in excess of existing sea disposal authorisations, and of Drigg's authorised capacity. In the specific case of a land-based facility at Wytch Farm in Hampshire, re-injection to the well-head is authorised by the Environment Agency.

2.34 In the light of these limited options, the Government is currently in discussion with the regulators to pursue the most appropriate disposal route for this material. Discussions are focusing on whether the re-injection of the material into the offshore oil and gas well-heads from where it originated represents the Best Practicable Environmental Option (BPEO), and whether it is consistent with the UK's international obligations under OSPAR – a Convention on protecting the North-East Atlantic from pollution – and the London Dumping Convention.

Box 3: Spent Sealed Sources

2.35 A 'sealed source' is a device in which a radioactive material has been contained within an outer casing. This outer casing makes an accidental release of the contents extremely unlikely. Sealed sources have an extensive range of medical, educational and industrial uses, notably in general diagnosis and cancer treatments, and in the oil and gas industries.

2.36 When the amount of radioactivity in a sealed source has diminished through natural decay to the point where it can no longer serve its original purpose, it is described as 'spent' and becomes waste. The time taken for a sealed source to become a waste varies with the half-life of the particular radionuclide. It can range from hours to hundreds of years. Some spent sealed sources can be recycled into new sources by specialist source manufacturers, reusing the radioactivity contained in them. Others are simply wastes, for which a management route must eventually be found.

2.37 Some sources decay to the extent that they can be disposed of by dustbin disposal or as LLW to Drigg, whilst others will remain as ILW for long periods. As the UK currently has no final management route for ILW, special arrangements entailing considerable cost are required for the long-term storage of these sources at dedicated sites, such as the spent source store run by the United Kingdom Atomic Energy Authority (UKAEA) at Harwell in Oxfordshire. Redundant sources are therefore frequently retained on small user premises. In addition to their own spent sources, small user organisations may also take control of sources that are found in the public domain (either as a result of accident, loss or abandonment) on a voluntary basis.

2.38 We are currently involved in a number of international initiatives to increase control over the management of spent sealed sources. The European Commission is preparing a Directive that will harmonise and improve the control of sealed sources within the European Union. The IAEA have also proposed an Action Plan to assist States in maintaining and, where necessary, improving the safety of radiation sources and the security of radioactive materials.

2.39 We have also noted the recommendations on spent sealed sources made by RWMAC in its recent examination of the problems experienced by small users in managing their radioactive wastes[6]. RWMAC concluded that small users face serious difficulties, primarily financial, in dealing with spent sources. Large ILW sources constitute a particular problem for hospitals and universities, whilst even the costs associated with small sources has meant that they are reluctant to take guardianship of sources discovered in the public domain. RWMAC's view is that the Government should consider the case for ring-fencing additional resources in order that the health and university sectors can make effective arrangements for the management of historic redundant registered sources for which there is no current budget,

continued overleaf

6 The Radioactive Waste Management Advisory Committee's Advice to Ministers on the Problems of "Small Users" of Radioactive Materials (September 2000)

and requiring arrangements to be put in place such that all sales of new sources include provision for future disposal. RWMAC also considers that for the UK a dedicated organisation could be given responsibility for taking abandoned sources under control.

2.40 We note that no serious accidents have occurred with lost sources in the UK, but recognise that there is no room for complacency. RWMAC's proposals require careful consideration in balancing the reduction in possible harm against the financial implications.

2.41 ***Views are invited on RWMAC's proposals for the management of spent sealed sources: the ring-fencing of additional resources for the management of historic redundant registered sources for which there is no current budget; requiring arrangements to be put in place such that all sales of new sources include provision for future disposal; and setting up a dedicated organisation with responsibility for taking abandoned sources under control.***

2.42 Appendix 1 summarises the main options for managing radioactive waste in the long term. These include:

- storage above ground
- disposal underground
- storage underground
- disposal at sea
- disposal under the seabed
- disposal in subduction zones
- disposal in ice sheets
- disposal in outer space
- partitioning and transmutation

CHAPTER 3

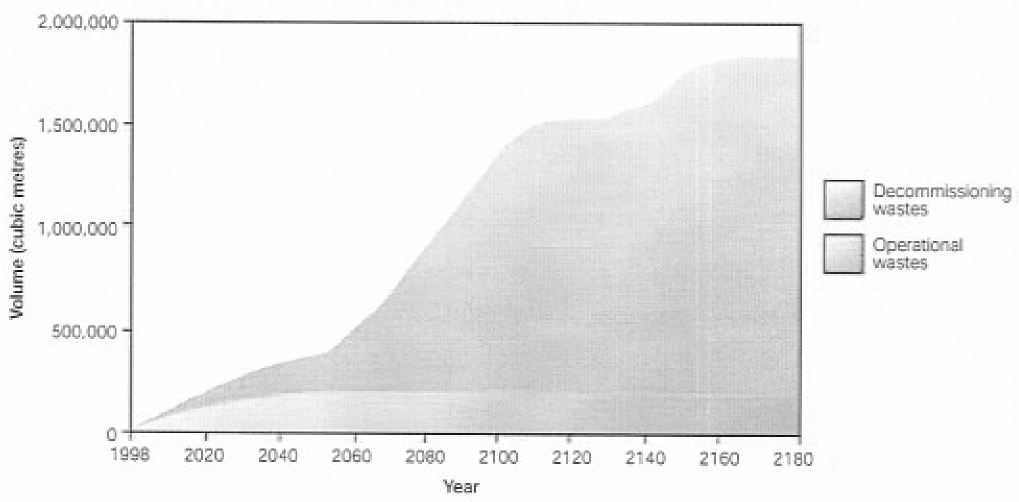
What wastes still have to be managed?

Summary

3.1 This chapter describes those radioactive wastes that are likely to arise from the remainder of the current UK nuclear power programme, continuing military activities and small users. It also examines materials that are currently not considered to be waste, but because their future use is uncertain, may at a later date be included in the Inventory, and may, therefore, impact on a waste management strategy.

3.2 VLLW and LLW will continue to be produced for the foreseeable future assuming radionuclides continue to be used in medicine, research and education. Landfill sites and incinerators will probably continue to deal with some of these.

Cumulative production of LLW in terms of conditioned volume

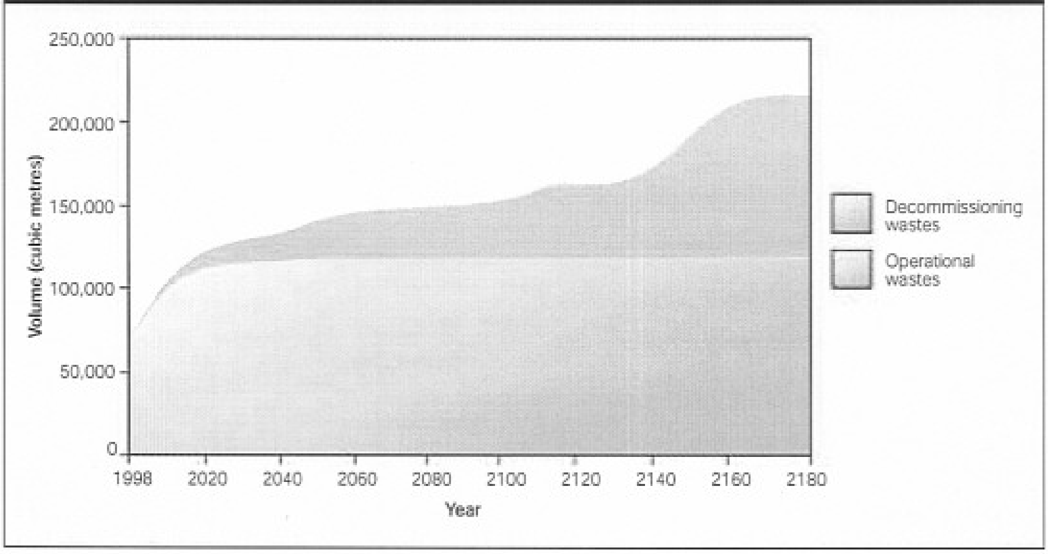


3.3 LLW will continue to arise from ongoing operations of the nuclear power industry and from military activities. The decommissioning of all today's nuclear facilities once they come to the end of their lives will continue throughout this century and possible the next and will also produce much LLW. In total about 1,800,000 m^3 of LLW is expected by 2160, this is far more than has been disposed of to the Drigg site since it opened. Drigg only has a finite capacity in the currently consented area and may be full by about 2050, hence new arrangements will have to be examined. Successor plans will need to be in place before then to deal with arisings of LLW requiring long-term management. The issues discussed in this consultation paper will be central to how these successor plans are chosen. We therefore expect that the potential management options for LLW post-2050 will be discussed in the next consultation paper at "Stage two" (see Table 1 in Chapter 7).

3.4 Dounreay will have appreciable LLW arising from decommissioning, and the management of these wastes is a subject of active study.

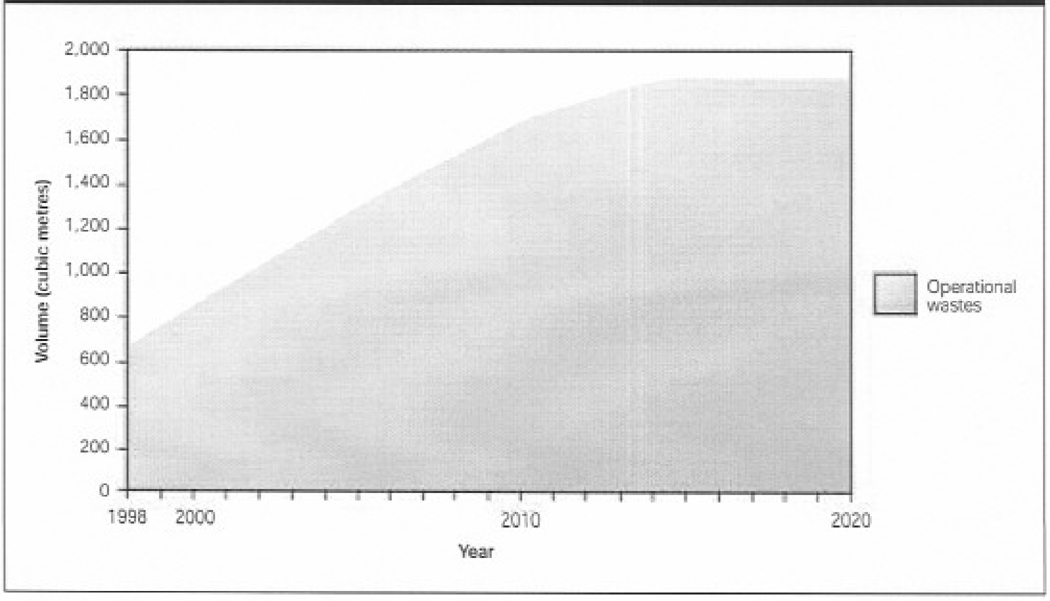
3.5 About 210,000 m³ of ILW will be arising almost equally from the continued operation of the current nuclear industry, and from decommissioning of existing facilities, that were not designed to modern standards for ease of decontamination. Storage buildings for this conditioned ILW will need to be constructed at the main nuclear sites whilst the long term management arrangements are determined. The arising of ILW from the non-nuclear industry is very small, but it is important that a route is available for the management of spent sealed sources not returned to manufacturers. Techniques are available for rendering ILW passively safe, and over time an increasing percentage of it will be conditioned. ILW from decommissioning will become more and more important as operation of our ageing reactors and facilities cease. Paragraphs 3.15-3.33 set out in more detail the factors that have to be considered in planning decommissioning.

Cumulative production of ILW



3.6 About 1000 m³ of conditioned HLW will arise from the completion of current reprocessing contracts by about 2015. Unless new reprocessing contracts are obtained at Sellafield no further HLW will be created there, other than a small amount from the decommissioning of the vitrification plants. The liquid HLW at Dounreay will also have to be converted to a more stable form for improved long-term management.

Cumulative production of HLW in terms of conditioned volume



WASTE SUBSTITUTION

3.7 Waste substitution is a means of marginally altering the proportion of wastes held in different categories and thus the management of some contaminated material.

3.8 All BNFL's new reprocessing contracts for overseas customers signed since 1976 have included a provision to return the resulting wastes back to the country of origin. However, BNFL has proposed that to reduce significantly the volume of wastes to be returned, and hence the number of waste shipments to overseas customers, it should be allowed to offer waste substitution to its overseas customers. This would involve returning a smaller amount of HLW that would be radiologically equal to the greater volume of LLW and ILW normally associated with reprocessing. The LLW would be disposed of at Drigg, and the ILW stored at Sellafield, pending a decision on long-term management arrangements.

3.9 Current Government policy is that HLW arising from reprocessing should be returned to the country of origin as soon as practicable after vitrification. BNFL is permitted to engage in waste substitution for LLW, for which a disposal route exists, but substitution for ILW is dependent on the construction of a repository for intermediate level wastes – or some other kind of waste management facility if the Government and the Devolved Administrations decide that disposal is not the right solution. In the absence of a facility, these wastes will need to be returned by the time BNFL is contractually obliged to return them (25 years after they are generated). The first return of HLW is expected to take place in the next few years.

3.10 Concerns over the trade implications of this arrangement have been raised by the House of Lords Science and Technology Committee[7], and the House of Commons Trade and Industry Committee[8]. BNFL have estimated that having to return wastes without offering waste substitution may cost them around £700 million in lost premiums on current and future contracts.

3.11 We note that waste substitution would decrease the level of waste shipments around the world. It would also result in a decrease in the volumes of HLW to be managed in the UK, and an increase in the volumes of ILW. These wastes represent only a small fraction of the volume of wastes of domestic origin, and their retention should not create any novel waste management problems. Nor should they increase the amount of radioactivity, since the radioactive content of the additional wastes to be returned would be no less than that in the wastes remaining in the UK.[9]

3.12 We note that RWMAC have supported the use of the "integrated toxic potential" system proposed by BNFL as a means of establishing the radiological equivalence between different waste categories. However, we note that RWMAC concluded that precise radiological equivalence could only be established once a site and design specific radiological assessment has been undertaken. This would only be possible once a final management strategy for ILW had been adopted. We also note that RWMAC advise that any minor, negative non-radiological consequences of substitution could be compensated by returning a small additional amount of vitrified waste over and above that calculated on radiological grounds alone.

7 House of Lords Session 1998-99 Third Report of the Select Committee on Science and Technology. "Management of Nuclear Waste" (March 1999)

8 House of Commons Session 1997-98 Eleventh Report of the Select Committee on Trade and Industry "Industrial and Trade Relations with Japan" (August 1998)

9 RWMAC "Review of Radioactive Waste Management Policy: Preliminary Conclusions" (August 1994)

3.13 We believe in the general principle of self-sufficiency in radioactive waste, and would not wish to take any step that would discourage other countries from providing their own waste facilities (all countries which have customers of BNFL's reprocessing service have domestic programmes for managing radioactive wastes from their own nuclear activities), or which would create a waste management problem in the UK. Any approach to substitution needs to recognise these principles as well as meeting the criterion of no overall detriment.

3.14 ***Views are invited on the link between waste substitution and the availability of a long-term management strategy.***

DECOMMISSIONING WASTES

3.15 Dismantling a closed down nuclear facility and removal of its contents, both radioactive and non-radioactive, is known as decommissioning. The key objective in decommissioning a nuclear facility is progressively to remove the hazard within an overall framework that ensures the safety of workers and the public, and protects the environment.

3.16 Decommissioning wastes may comprise ILW, LLW and VLLW in varying proportions. They are different from operational wastes, as they are mostly building materials and larger items of plant and equipment. The major components are concrete, cement and rubble, metals and graphite. After 2020, most ILW will arise from decommissioning. At 2100, the conditioned volume of wastes generated is expected to be about 150,000m^3. The rate of arising increases after 2100, as nuclear power station decommissioning is completed. In total, about 50% of all expected ILW will be from decommissioning existing facilities.

3.17 Nuclear facilities include power stations, stores, chemical plant and research facilities. The HSE's Nuclear Installations Inspectorate regulate all operations on a licensed nuclear site, including decommissioning. MOD operates sites under its control to equivalent standards. Radioactive wastes will also be generated by decommissioning some unlicensed civil facilities including the Joint European Torus (where research on fusion is undertaken), oil and gas production, and gas processing facilities, but this is not considered further here.

3.18 All radioactive materials become less radioactive over time as a result of radioactive decay. The half-lives (the time in which the radioactivity levels decrease to half their initial value) for the main radionuclides in decommissioning wastes range from less than a year to many tens of thousands or even millions of years. As a result of this decay, nuclear facilities become less radioactive over time but the extent and speed at which this occurs varies from one facility to another. Facilities contaminated with plutonium present a special case, in that the build-up of americium 241 (from the decay of a plutonium isotope) can result in increased radiological hazard from increased gamma irradiation over time.

Decommissioning Objectives

3.19 The key objective in decommissioning a nuclear facility is to remove the hazard progressively within an overall framework that ensures safety of workers and the public and protects the environment. For example, buildings could be stripped of their radioactive contents and associated radioactivity and be made available for nuclear or non-nuclear purposes. Alternatively, buildings could be completely removed so that the land on which they stand becomes available for other uses. Once all the facilities on a licensed nuclear site have been decommissioned, the site itself can be de-licensed, providing it meets HSE criteria. These stem from the Nuclear Installations Act requirement that there should be "no danger from ionising radiations" from anything remaining on the site. HSE are developing guidelines on the practical interpretation of this requirement. Decisions on decommissioning, and seeking de-licensing, which may be influenced by the results of an environmental impact assessment (see paragraph 8 below), are normally taken by the licensee, who is responsible for the decommissioning process, in consultation, as appropriate, with the regulators and the local planning authority.

3.20 The licensee is responsible for keeping its decommissioning strategy up-to-date and for ensuring that adequate resources are, or will become, available to carry it out. HSE's Nuclear Installations Inspectorate reviews each licensee's decommissioning strategy every five years, in consultation with the relevant environment agency. HSE 's review is made public.

Issues to be Considered in Developing Decommissioning Strategies

3.21 There are many issues to be considered when drawing up a decommissioning strategy for a nuclear facility. They include the type of facility (e.g. power station, chemical plant), its age, the condition of buildings and equipment, the level of radioactivity, the radionuclides involved and their concentration, or dispersal, around the facility, and many others. The aim in broad terms should be to achieve an appropriate balance consistent with legal requirements between safety and health, environment and economic factors. The following paragraphs indicate how this might be approached.

TIMING

3.22 Decommissioning should be carried out within the normal statutory framework which includes the requirement that so far as reasonably practicable activities should be conducted without risks to people's safety and health. This implies reaching a reasonable balance of safety and health, environmental and economic factors. While this means that in many cases work will start sooner rather than later, in some cases the balance will point to deferral.

3.23 For nuclear reactors an environmental impact assessment must be produced and agreed with the HSE before decommissioning operations can begin. Early decommissioning has a number of advantages. For example, it could result in the removal of a large structure, often in an isolated and rural area. It would also avoid leaving problems for future generations to deal with. Optimum use could be made of the expertise available among the staff with recent knowledge of the layout, contents and overall nature of the plant, which might be lost if the start of decommissioning is deferred. It could also optimise the amount of site material available for reuse at the facility or elsewhere, or for recycling.

3.24 However, early decommissioning of, say, a nuclear power station could produce considerably more radioactive waste (two to four times as much intermediate level waste) than delaying the removal of the reactor and its biological shield by between 50 to 90 years. It may also result in slightly higher levels of liquid and gaseous discharges from site during decommissioning operations. Leaving the facility intact for a while would reduce not only the amount of intermediate level waste produced but overall radioactivity levels too. For example, in the case of cobalt-60, which has a half life of 5.3 years and can be found in steel components within reactors, there could be benefit in delaying decommissioning activities for a few decades to allow the radiation hazard to reduce significantly. However, as noted in paragraph 3.18 above, in the case of plutonium contaminated facilities, there is benefit in carrying out decommissioning operations without significant delay to avoid the build-up of americium.

3.25 HSE requires licensees to develop decommissioning strategies in line with current technology. Delaying decommissioning might benefit from the development of new technologies, though this should not be relied upon. Security and safety issues would need to be addressed to ensure no loss of radioactive materials, or loss of containment throughout any period of deferral. In the case of reactors, early removal of radioactive material from the reactor (to be stored in waste containers) could increase the risk of radioactivity leakage consistently with the management of health and safety at work regulations, the aim should be to achieve a state of passive safety (that is, requiring little or no human interference) as soon as reasonably practicable.

SAFETY

3.26 Safety, both radiological and conventional, needs to be ensured throughout the decommissioning process. The hazard posed by the facility should be progressively removed on a timescale agreed with HSE. Early decommissioning might enable a tighter timescale to be achieved but this is also when radioactivity levels are highest (and therefore most dangerous), and generated waste levels are greatest. Delaying decommissioning allows radioactivity levels to decrease to safer levels, but requires continuing high levels of structural and radiological integrity in the meantime. Necessary resources, knowledge and skills also need to be maintained until decommissioning is completed.

3.27 Dismantling of non-radioactive structures, or equipment, is normally carried out manually. The longer the facility has been closed down before decommissioning of radioactive areas begin, the greater the opportunity for manual intervention – even in the more radioactive areas such as reactors. However, remote techniques (robotics) for these operations already exist and are being further developed. Use of robotics would enable decommissioning to start immediately after close down without compromising worker or public safety but would, in itself, lead to the creation of larger amounts of radioactive waste. Such techniques may prove to be slower, less resource efficient and more expensive. However, they could allow an earlier start to decommissioning and offer safety benefits.

COSTS

3.28 Financial considerations are also relevant. The timing of decommissioning should not be determined solely by financial implications, although this may be a significant factor. Completely decommissioning a facility immediately after close down would result in higher costs because of the more complex techniques and increased levels of shielding required and because of the larger volume of higher level waste produced. For reasons set out above, costs normally reduce if work on the most radioactive parts of the plant is delayed. But costs tend to reach a relatively constant level at a particular point in time, which varies according to the type and nature of the facility. This can usually be predicted in advance of closure, although changes in technology over time can be influential. Additionally, because of investment growth the longer the delay before incurring costs, the smaller the amount which needs to be put aside at the outset to produce the sums required to cover future costs. The financial implications of decommissioning will be a significant factor to the licensee in deciding their strategy and all options should be appraised using an appropriate discount rate. HSE will want to be assured that sufficient resources are/will be available to cover decommissioning costs, no matter when decommissioning actually begins. For British Energy, the Government has required the establishment of a properly managed and segregated fund to meet such costs.

3.29 Costs are likely to increase from any delay in decommissioning beyond a few years because of the need additionally to maintain the facility in a safe and secure condition. These would have to be balanced against the financial advantage in delaying decommissioning and in some cases, maintenance, monitoring, security and refurbishment costs could cancel out any benefits. The cost of waste disposal could increase in real terms but given that the UK's current low level waste disposal facilities are expected to operate for a further 50 years, any such increases are not expected to materialise. The cost of using a new waste disposal facility, however, may be higher in real terms. The UK currently has no intermediate level waste disposal facilities and there is, therefore, no scope for making savings in this area by early decommissioning. The cost of storing intermediate level waste until a long term solution has been found, would probably be greater than the alternative which would be to leave the facility in situ in a safe and secure condition.

TECHNICAL DEVELOPMENTS

3.30 Current techniques available for decommissioning, and the likelihood of new innovations being developed, are important considerations. In drawing up a strategy it is important to recognise that during actual decommissioning new and improved technologies and techniques will become available. During decommissioning itself full advantage should be taken of any improved techniques that offer safety, environmental or cost benefits. For this reason it is important that the strategies are reviewed regularly, and revised as appropriate, so as to maximise the benefits arising from new technical developments.

3.31 Following these principles should allow robust and effective decommissioning strategies to be produced. However, what is set out above is by no means an exhaustive list of the issues that need to be addressed. Rather it illustrates some of the issues that need to be considered in drawing up a decommissioning strategy. We believe that decommissioning strategies should continue to be prepared on a facility by facility basis. Strategies should be living documents and reviewed for their adequacy by HSE every five years. For nuclear reactors, the statutory consultation required by the environmental impact assessment process also needs to be built in.

3.32 We believe that the timetable for decommissioning should be determined by the licensee, in conjunction with the HSE. It should take into account all relevant factors including the type of facility, the nature of its radioactive inventory, the techniques needed to ensure worker safety and to protect the public and the environment, the costs of various options, and overall financial, economic and national resource issues.

3.33 ***Views are invited on the general approach outlined for decommissioning.***

3.34 We have considered the future management of wastes similar to those we have today. There are two other types of wastes that may have to be managed:

- those from a hypothetical new nuclear power programme; and

- those which are today regarded as strategic commercial materials but which might at some date be classified as wastes.

NEW NUCLEAR POWER PROGRAMME

3.35 If new nuclear power stations were built, this would add to the total amount of waste that we would have to manage. However, it is likely that the volumes of waste produced per unit of electricity sent out will fall below those achieved today. The current most modern reactor in the UK, the Sizewell B pressurised water reactor, produces about 10% of the LLW and ILW produced by the first generation Magnox reactors commissioned in the 1960s when normalised to the same amount of power produced. Wastes will be generated whether spent fuel is reprocessed or not, though the amount and type of waste varies between one option and the other.

MATERIALS NOT CURRENTLY CLASSIFIED AS WASTES

3.36 There are some radioactive materials that are not currently classified as waste, but for which future use is uncertain. If, at some point in the future, it were decided that there was no use for these materials, there could be significant factors to consider for their long-term management. Additions of materials at a later date may require changes to plans which are more costly than incorporating them at an earlier time, and could also undermine consensus building. We believe that the policy for the management of radioactive materials should be as comprehensive and forward looking as possible, and that therefore some consideration should be given to these materials now. It would be preferable to begin the process to develop a waste management strategy with a clear idea of which materials might be included within the strategy.

Plutonium

3.37 Plutonium is produced by the irradiation of uranium fuel in a nuclear reactor. Plutonium can be separated out from recovered uranium during reprocessing and converted into insoluble plutonium dioxide. This process has been carried out in the UK at both Sellafield and Dounreay. Plutonium is generally more fissile than the uranium recovered by reprocessing, and has to be handled carefully in kilogram amounts so as to prevent a "criticality", the same process which is at the heart of nuclear power and nuclear weapons.

3.38 On 31 December 2000, there were 61.5 tonnes of UK civil separated plutonium in the UK, most of which is stored in special arrays within certain facilities at Sellafield. The policy for the management of UK stocks of the material was set out in "United Kingdom Civil Nuclear Policy including Plutonium", which was published in January 1998. This underlined the UK Government's commitment to ensure that holdings of plutonium under its jurisdiction are managed safely and effectively in accordance with its international commitments on non-proliferation and in ways which ensure the protection of workers, the public and the environment. The Government's policy is designed to prevent the risk of the material being stolen or diverted for misuse.

3.39 Plutonium is potentially a valuable energy source and was originally intended to be used as a fuel for fast reactors. However, the demise of the UK fast reactor programme now makes this less certain. Plutonium can be used as a component in Mixed Oxide fuels (MOX) in reactors such as Sizewell B or in other more advanced reactor designs. In this form one tonne of plutonium typically contains the same amount of energy as 2 million tonnes of coal. BNFL reprocesses substantial quantities of fuel from overseas customers and have returned plutonium as MOX fuel which has been used in Germany and Switzerland. Japan and Sweden are also potential customers. However, there are currently no reactors in the UK authorised to use MOX fuel, and British Energy have no plans to use MOX fuel in Sizewell B as they currently consider it a more expensive option than fresh uranium fuel.

3.40 A factor which is relevant to the potential to use plutonium for power production is the ingrowth of americium-241 (Am241). Am241 is a radioactive isotope which forms from the radioactive decay of plutonium-241 – which has a half-life of approximately 14 years. The longer separated plutonium remains in storage the more Am241 builds up and, because Am241 strongly absorbs neutrons, this renders the plutonium less useful as reactor fuel as time progresses. The original Am241 content is determined by the reactor type and burn-up of the fuel (i.e. the power output and how long fuel remains in the reactor). Since the majority of UK plutonium stocks (over 90%) originate from Magnox reactors with relatively low burn-up the build-up of Am241 is relatively slow. It is also possible to treat ageing plutonium to remove Am241, although this adds to the cost of fuel manufacture and is thus a factor in the fuel's competitiveness with other fuels. While this treatment would not involve any new technology, the facilities to treat the aged plutonium would need to be constructed and gain regulatory approval before they could be brought into operation.[10] There is also a requirement to blend plutonium arising from different sources before fuel manufacture in order to obtain a homogenous product. It is estimated that about 50% of the current stockpile would require blending. A further 10% may not be in a pure state and, if chemically contaminated, would require treatment to remove chemical impurities as well as Am241.

3.41 The House of Lords Select Committee on Science and Technology[11] recommended that a strategic stock of plutonium should be retained in case it was required to fuel fast reactors in the future. They suggested that because of the waste management implications presented by plutonium, the remainder of existing stocks be declared as a waste. The Royal Society report "Management of Separated Plutonium"[12], considered that there was an international consensus against large stocks of separated civil plutonium, because of the environmental and security risk posed, and also called for the disposal of some plutonium as waste. More recently, the House of Commons Trade and Industry Select Committee have, in the conclusions on reprocessing contained in their report on the proposed BNFL Public-Private-Partnership (May 2000) stated that: "...plutonium separated from used fuel is not only no longer required by any end-user, but it is increasingly regarded as a positively dangerous waste product."

10 There is no firm estimate of the amount of plutonium that would require treatment to remove americium before it could be used as MOX fuel. The safety case for the proposed Sellafield MOX Plant (SMP) assumes that the production of MOX fuel is limited to plutonium that has been stored for five years since being separated from spent Pressurised Water Reactor (PWR) fuel. However, no UK plutonium is derived from this source. To have reached the same level of americium build-up as five year old plutonium originating from PWR fuel, plutonium separated from spent AGR fuel would have had to have been stored for around eight years or more, and plutonium from spent Magnox fuel for around twenty years or more. About a third of the current UK stockpile falls into these categories. However, the assumptions used in the safety case for SMP are sample scenarios for a pre-commissioning safety case. They are not rigid operating criteria. If Ministers decide that SMP's operation is justified, actual experience of operating the plant may lead to a change in these assumptions. It should also be noted that the safety case imposes no specific limits or operational constraints on the americium content alone of the plutonium coming into SMP. Limits are applied to the operator radiation doses and heat loadings, and americium is just one contributor to these.

11 House of Lords Session 1998-99 Third Report of the Select Committee on Science and Technology. "Management of Nuclear Waste" (March 1999)

12 Royal Society "The Management of Separated Plutonium" (February 1998)

3.42 Plutonium is currently retained in safe secure stores with appropriate security and international safeguards to ensure that it is not misused. The stored material is available as a potential fuel, and continued storage would not foreclose that option for the future. This is potentially important because although there are no current proposals for new nuclear capacity, [there are longer term uncertainties about the need for future nuclear capacity to meet climate change – an issue advocated in the Royal Society report "Nuclear Energy: The Future Climate".[13]] If new nuclear build were brought forward, reactors could be designed specifically with enhanced plutonium burning capabilities.

3.43 If plutonium, unsuitable for MOX fuel, were categorised as waste it would, in common with other forms of radioactive waste, be included in the UK's Radioactive Waste Inventory which is compiled by the DEFRA and Nirex. In line with the principle of inter-generational equity, there would also be a requirement that financial provisions should be made, such that if the option to re-use were not taken, the material could be treated in readiness for its long-term management. Even on the assumption that such action would not take place for many years, the requirement for such provisions would have significant financial implications for the owners of the plutonium. As the main owners of the material, the majority of the liability would fall to the public sector. Accurate costings for treatment and possible long-term management options for plutonium are not available and estimates vary widely, they are however likely to be of the order of billions of pounds. Further work on costs will be undertaken within Government and the views of the public will form an important contribution to this work.

3.44 If some plutonium were classified as a waste, the combined stocks would, for the present, continue to be stored at Sellafield. It could be treated to reduce even further its potential for misuse. Treatments which have been considered for similar materials in other parts of the world are encapsulation in glass or ceramics, and mixing the plutonium with high level wastes (HLW) to create a radiation barrier and thereby reduce further the remote risk of illicit diversion. However, due to radioactive decay, this barrier would only be effective for a few hundred years. There would be a requirement for preparatory research and plant modifications before plutonium could be mixed with existing HLW streams. This is a possibility if THORP continues to operate beyond 2015, the date currently set by HSE for BNFL to reduce stocks of liquid HLW to minimum safe "buffer" levels. However, the implications of treating plutonium in this way would be to foreclose the potential to extract the energy value of the material. Because of the need to carry out this work early, it would be more expensive than retention in current stores, with costs estimated at hundreds to thousands of millions of pounds – depending on the method of treatment used. Most of any costs would fall to the public sector to fund.

3.45 In view of the large stock of plutonium existing in the UK, the fact that a fraction of it is currently unusable as MOX fuel, and the lack of UK reactor capacity to accept MOX fuel, it is important to consider whether some of the plutonium should now be classified as waste. Any assessment will also need to take account of the energy value of the plutonium stocks should changing economics or considerations such as climate change make new nuclear capacity attractive. The consequence for liability provisioning is also a relevant factor, particularly if early treatment to reduce the potential for further use were to be adopted.

3.46 ***Views are invited on the policy to be adopted for the long-term management of UK separated plutonium, including whether some of the stocks should be considered as waste.***

13 Royal Society "Nuclear Energy: The Future Climate" (June 1999)

Box 4: Statement From the Owners on the Possible Future Uses of Plutonium

British Nuclear Fuels (BNFL)

3.47 "BNFL continues to keep under review future options for all material containing plutonium on its site, taking into account possible uses, economics and environmental and safety issues. As a result, and taking into account plutonium's significant potential as an energy resource, BNFL's strategy is that its separated plutonium should, as far as possible, ultimately be used as MOX fuel. Many nuclear utilities are already keen to recycle their plutonium for further use as MOX. For this reason, BNFL consider it would be wrong to designate any of the plutonium as waste. In the meantime, the plutonium is stored under international safeguards."

The United Kingdom Atomic Energy Authority (UKAEA)

3.48 "If chemically separated, the majority of UKAEA plutonium is of suitable isotopic composition for the manufacture of MOX fuel. MOX fuel could be manufactured for use in either thermal reactors or future fast reactors."

British Energy (BE)

3.49 "BE will consider in due course which option or options to choose for the ultimate management of its plutonium. These options include recycle in Sizewell B or other reactors internationally, should it become economic, and disposal. Recycle of plutonium based fuel in AGR power stations has been assessed but is not considered practicable without significant investment. Safety case and consent issues will need to be addressed for each potential option.

3.50 If Government policy deemed plutonium as a waste requiring treatment on an early timescale, it would undermine still further the rationale for reprocessing i.e. that it results in the production of potentially re-usable nuclear fuel. In such a situation it would be nonsensical for BE to continue with reprocessing and the creation of a further liability."

Ministry of Defence (MOD)

3.51 "The Ministry of Defence maintains the minimum stockpile of plutonium outside of international safeguards to meet the requirements of the nuclear weapons programme. The Strategic Defence Review (SDR) in 1998 concluded that plutonium no longer required for Defence purposes would be placed under international safeguards. The quantity of such safeguarded plutonium owned by MOD is a very small percentage of the overall UK safeguarded plutonium stock. MOD will, therefore, take note of civil industry plans for dealing with this material."

Uranium

3.52 There are two main forms of uranium that may be surplus to requirements. Depleted uranium in the form of uranium hexafluoride tailings (hex tails) is a by-product of fuel fabrication and enrichment. Depleted reprocessed uranium is derived from reprocessing irradiated fuel and represents 96% of spent fuel from which plutonium and waste materials have been separated.

3.53 Reprocessed uranium can be, and some from the Magnox programme has been, used to manufacture new AGR fuel. However, it is currently uneconomic to use for this purpose due to the low cost of fresh uranium and the material is kept in storage. Dependent on uranium prices, it can be economic to enrich some of the depleted hex tails in order to produce new fuel, and this is done when economic conditions are favourable. Depleted uranium can be mixed with plutonium to make MOX fuel, and some also finds use in mixing with highly enriched uranium, formerly used in military applications, a process known as down blending. Radiation shielding applications and limited other industrial applications make use of specific properties of the material. If required depleted uranium could be used to generate additional fuel in a fast breeder reactor. It is estimated that the combined stocks of reprocessed and depleted uranium is of the magnitude of 50-60,000 tonnes, and could eventually rise to over 100,000 tonnes – although these figures could be reduced according to use.

3.54 The measures which could be taken to address the issue of stocks of both reprocessed and depleted uranium are similar to those for plutonium. To avoid foreclosing any options for the future the materials could be retained in their current forms in safe secure storage. This would retain reprocessed uranium as a potential fuel should factors, such as an increase in the cost of fresh uranium, make its future use economic. It also prevents the foreclosure of management options for both reprocessed and depleted uranium should it eventually be decided that there is no future use for these materials. Reprocessed uranium stored as drummed uranium oxide is already regarded as passively safe and depleted uranium hexafluoride could be treated to put it in a similar passive form for long-term storage pending a decision on future options. While this could be achieved without foreclosing the option of future use, the costs would be significant.

3.55 If it were decided that the uranium is not going to be used in the future it would be appropriate to treat the material to put it in a form where it is unavailable for use. This would foreclose any future possibility of extracting the energy contained within it and require that in addition to the treatment costs, substantial financial provisions should be made for its long-term management. This would have significant financial implications – particularly for the public sector.

3.56 In view of the large stock of uranium existing in the UK, the question arises whether this material should be retained for possible re-use in the future or if some should be considered as a waste. Factors important in deciding its fate will include the form in which the uranium is currently stored, its energy potential, should economic conditions alter, the potential for non-nuclear use, and the issue of liability provisioning. Uranium for nuclear fuel has been extracted from mineral bodies close to the surface and via deep mines. The stable minerals have existed over millennia.

3.57 ***Views are invited on the policy to be adopted for the long-term management of UK uranium stocks, including whether some should be considered as waste.***

Box 5: Statement from the Owners on the Possible Future Uses of Uranium

BNFL

3.58 "BNFL continues to keep under review future options for all uranium material on its sites, taking into account ownership, possible uses, economics, environmental and safety issues. There are a number of possibilities for the future use of uranium."

3.59 "BNFL and its customers view most uranium, whatever its form, as an asset for use as fuel. Where possible, used fuel will be recycled to make available the uranium for use in fresh fuel. To date, over 19,000 tonnes of uranium has been recycled into fresh fuel. At present, all uranium from overseas customers will be returned to them in one form or another."

UKAEA

3.60 "The majority of UKAEA's uranium, if chemically separated, is suitable for use in nuclear fuel production. The UKAEA's fuel management reference strategy is, therefore, to recover, if economically and environmentally justifiable, uranium for future use outwith the UKAEA. Thereafter, condition the wastes for storage and eventual disposal in a common form."

BE

3.61 "BE has the option of recycling uranium recovered from the reprocessing of AGR fuel in its reactors. However, the case still needs to be made that this is economic, operationally practicable, and safe. In the mean time, BE has arrangements with BNFL for the long-term storage of this uranium in purpose built, safe, secure and licensed facilities."

Urenco

3.62 "Urenco's stocks of depleted uranium are suitable, with appropriate enrichment, for use in reactor fuel, and this is being undertaken where it is currently economic. The remainder is currently being stored for future use."

MOD

3.63 "The MOD maintains the minimum stockpile of uranium outside of international safeguards to meet the requirements of the nuclear programmes. The Strategic Defence Review in 1998 declared that there is no surplus stock of Highly Enriched Uranium. However, it was concluded that non-highly enriched uranium no longer required for defence purposes would be placed under international safeguards. The quantity of such safeguarded uranium owned by MOD is a very small percentage of the overall UK safeguarded stock. MOD will, therefore, take note of civil industry plans for dealing with this material."

Spent Nuclear Fuel

3.64 Current policy is that the decision to reprocess or hold spent fuel in long-term storage pending direct disposal is a matter for the commercial judgement of its owners. Because of the potential value to the owners of plutonium and uranium derived from reprocessing spent nuclear fuel these materials have not previously been classified as waste. These issues are discussed above. If the classification of reprocessed uranium and plutonium were reconsidered this would have implications for the rationale of producing more.

3.65 Spent nuclear fuel is fuel removed from a reactor after final use. The main commercial UK fuels are Magnox, AGR and PWR. Typically, spent fuel is made up of approximately 96% unreacted uranium, 1% plutonium, and 3% waste products. The precise composition depends largely on the type of reactor and the amount of power produced by the fuel. Both AGR and PWR spent fuel elements can be stored for long periods. Alternatively, after a cooling period of at least three years for AGR spent fuel and five years for PWR spent fuel, it can be reprocessed – enabling the separated uranium and plutonium to be recycled. The remaining waste product primarily consists of high level, or heat generating wastes. This is currently stored at Sellafield and Dounreay. At Sellafield it is being mixed with glass (vitrified) and stored in purpose built facilities for at least 50 years to cool.

3.66 Unlike spent AGR and PWR fuel, the direct disposal of spent Magnox fuel is not a practical option. This is because Magnox corrodes when exposed to water, and it would be extremely difficult to guarantee dry storage for very long periods of time, particularly since, with one exception, the fuel removal and storage arrangements at all Magnox power stations involve storing the fuel under water. Given the limited life of the Magnox power stations, and the time needed to develop safety cases for major plant modifications, it is unlikely to be cost-effective to develop alternative arrangements for this fuel. Even if all Magnox stations were closed immediately there would be a requirement to continue reprocessing Magnox fuel for several years to come.

3.67 Reprocessing in the UK is primarily carried out at Sellafield where approximately 2,600 people work directly on the reprocessing of uranium oxide spent fuel and 1,650 people on reprocessing Magnox fuel. Reprocessing of oxide spent fuel accounts for approximately one quarter of BNFL's turnover and is therefore important to the economy of West Cumbria where Sellafield is located. BNFL currently has substantial contracts with British Energy to reprocess its spent fuel. In addition to reprocessing spent fuel for domestic customers, BNFL also undertakes this work commercially for overseas customers. It is a Government requirement that the products and wastes produced from this work are returned to the country of origin. This work does not therefore have any direct impact on the management of UK radioactive wastes.

3.68 Reprocessing has also been performed on a smaller scale at Dounreay, although no reprocessing has taken place since 1996, following the failure of the dissolver in the reprocessing plant. It was announced on 5 June 1998 that Dounreay should take no further commercial reprocessing work and that reprocessing would end there when the plant had completed reprocessing its own fuel, the Highly Enriched Uranium from Georgia, and its existing commercial contracts. A separate consultation exercise has been carried out by DTI in relation to some of this material, following which the Government has announced that no further reprocessing will take place at Dounreay.

Box 6: Statements from the Owners on Future Use of Spent Nuclear Fuel

BNFL

3.69 "A major part of BNFL's work is managing fuel which has already been used to generate electricity. All of BNFL's spent fuel arises from the Magnox programme. For technical and safety reasons, the fuel ultimately needs to be treated in some way to prevent corrosion. The best currently available option, from a technical, environmental and economic point of view, is to reprocess the fuel, separating out the uranium and plutonium, and vitrifying the waste. BNFL intends to reprocess all its Magnox fuel."

UKAEA

3.70 "The UKAEA's fuel management reference strategy is to recover, if economically and environmentally justifiable, uranium for future use outwith the UKAEA. Thereafter, condition the wastes for storage and eventual disposal in common form."

BE

3.71 "The AGR stations were designed with limited spent fuel storage capacities and their continued operation is dependent on dispatching spent fuel to an alternative management facility for reprocessing or storage pending final disposal.

3.72 "Reprocessing and recycling of products have been assessed to have broadly similar environmental impacts to long-term storage/direct disposal. BE has contracts with BNFL for the management of AGR spent fuel and these cover delivery of fuel well into the future. Some of these contracts allow for the reprocessing or storage of spent fuel at BNFL's discretion. There is no price reduction to BE if BNFL store fuel even though spent fuel management options based on long-term storage would have significantly lower costs than those based on reprocessing. Changes in Government policy on management of the products of reprocessing could further increase the cost of the reprocessing option. In addition, under current contracts, reprocessing costs are linked to RPI and therefore are escalating at a time when electricity prices have generally been falling. This has a significant impact on BE's ability to generate electricity at competitive prices. BE considers that it should have the right to choose long-term storage as the most economic spent fuel management option for the future.

3.73 "Sizewell B has substantial capacity for the storage of irradiated fuel and no decision needs to be taken at this stage on whether to reprocess or directly dispose of this fuel in the long-term."

continued overleaf

MOD

3.74 "MOD policy is for the indefinite storage of submarine reactor spent fuel. Financial provision has been made on this basis. Presently, spent fuel is stored in a core pond at Sellafield (B27). This pond has a finite life and from December 2001 a new facility will be available at Sellafield to accept spent fuel from the submarine refits and the used fuel presently stored in B27.

3.75 "Reprocessing does not reduce the volume of material to be stored, but whether or not this fuel is to be reprocessed also depends on the usefulness of the recovered uranium. When a decision was made to contract for the new spent fuel storage at Sellafield, it was not considered economically viable to reprocess MOD spent fuel. However, the economics of reprocessing could change and this decision is subject to periodic review. Therefore, although presently committed to storage in the new facility at Sellafield, the MOD retain the option of reprocessing their spent fuel."

CHAPTER 4

The Hazards and Risks of Radioactive Waste Management

Summary

4.1 This chapter describes hazard and risk and sets out how they apply to radioactive materials, and the management of radioactive waste.

Hazards and Risks

4.2 A hazard is an activity or substance capable of causing harm. Every activity or substance, to a greater or lesser extent, contains some degree of hazard. Risk is the chance that an activity or substance will cause harm. The level of risk is related to the degree of hazard inherent in an activity or substance. However, preventative action can usually be taken to reduce the size of the risk involved, either by reducing the likelihood that a harmful event will occur, or by reducing the severity of its consequences.

The Hazard from Radioactive Materials

4.3 The major hazard from radioactive materials is that their radioactivity can cause cancer. The risk of getting cancer is small at low doses of radioactivity, but increases as the doses get larger. There are two ways in which radioactive materials can cause cancer:

- Firstly, all radioactive materials pose an internal hazard if taken into the body by consuming contaminated food and drink or breathing contaminated air. The risk from this hazard is eliminated if radioactive materials are 'contained' in such a way that prevents them from entering the food chain or escaping into the air. This can be achieved by solidifying any liquid or gaseous material and putting it in containers.

- Secondly, some radioactive materials emit radiation with enough energy to travel large distances through the air. This poses an external hazard to the skin and tissues beneath, even when the radioactive material is not in contact with the body. The risk from this hazard can be eliminated if the radioactive material is 'shielded' to prevent the energy escaping. Some radioactive energy can be shielded by a sheet of paper, while other types can only be reduced substantially by thick pieces of lead, concrete or other materials.

4.4 The Government and the Devolved Administrations apply a strict regulatory regime to minimise the risks from the hazards associated with radioactive materials. Safety of people and the environment is the paramount concern. The Health and Safety Executive regulate and monitor doses from materials used and stored on nuclear and non-nuclear sites to ensure that they are within internationally recognised health limits. These limits are regularly reviewed to ensure they are based on the best possible scientific advice.

Additionally, the Environment Agencies regulate and monitor the discharges and disposals of radioactive wastes from sites, and the resultant levels of activity in the environment, to ensure their impacts are also within recognised health limits.

Risks Associated with the Management of Radioactive Waste

4.5 Because it will take a few hundred thousand years before some radioactive wastes are no longer hazardous, there is inevitably some uncertainty as to whether the management options, aimed at reducing the level of risk, will perform satisfactorily over this period. Clearly, nobody knows what events will physically and politically shape the country over the next few hundred thousand years.

4.6 Long-term changes in the natural environment, such as climate change, over the timescales required for radioactive waste management cannot be predicted with any great degree of confidence. Making long-term political or economic predictions is even harder. It is just over two hundred years since the Industrial Revolution started and great strides forward in science and technology have been made during that period. It is possible that we may advance much further over the next two hundred years. The recent mapping of the human genome, for example, holds out the possibility of cures for cancer that may one day affect how the risks from radioactive waste are perceived.

4.7 However, it is also possible that the future may not be one of scientific progress. The last two hundred years have seen many wars and conflicts. Whole countries have risen and fallen. The resources we have now may not be available to our descendants in the future. Scientific advances, such as the mapping of the human genome and any cure for cancer that is later developed, could be lost.

4.8 There is even less certainty over how society will evolve during the next few hundred thousand years in which radioactive wastes will remain hazardous. It is, therefore, important that all is done now, before an option is chosen, to make sure that the best decision is taken. We therefore believe that all management options should be opened up to the widest possible scrutiny, so that any flaws are spotted now. The more rigorous the scrutiny, the more chance there is that the best decision will be taken. The next two chapters examine in more detail how we intend to encourage this scrutiny.

CHAPTER 5

A Public Debate

Summary

5.1 This Chapter describes some techniques for bringing people into the decision-making process, and invites views on the suitability of these techniques for the debate on radioactive waste management policy. It also sets out how some of these techniques will be applied to the current consultation process.

Public Acceptability

5.2 We need people's help to build the policy for managing radioactive waste if this is to earn wide public support. Experience from Nirex's attempts to investigate the feasibility of a repository at Sellafield and elsewhere, has demonstrated that unless people believe that the right policy has been adopted for the right reasons, they will strongly resist its implementation.

Engaging the Public

5.3 The Government and the Devolved Administrations want to provide more opportunities for public participation in environmental decision-making. In line with this commitment, the UK has signed the Aarhus Convention, the international convention on environmental information and public participation, which obliges it to involve the public in decisions about radioactive waste[14].

5.4 The issues associated with the management of radioactive waste are technically complex. We need to provide the widest opportunity for participation by people throughout society, without over-simplifying complex issues. To achieve this, we need to use a variety of methods for public participation sensitive to people with differing levels of knowledge and experience. We should be innovative in our approach and consider a variety of methods both traditional and novel.

5.5 A great deal of work has already been done on identifying and assessing these techniques, by the Royal Commission on Environmental Pollution,[15] Nirex[16] and the House of Lords Select Committee on Science and Technology[17].

14 The text of the Aarhus Convention can be found at www.unece.org/env/download/cep43e.pdf

15 Royal Commission on Environmental Pollution Twenty-First Report "Setting Environmental Standards" (October 1998)

16 Nirex "Environmental Impact Assessments and Geological Repositories for Radioactive Waste" (May 1999)

17 House of Lords Session 1999-00 Third Report of the Select Committee on Science and Technology. "Science and Society" (February 2000)

5.6 When considering which techniques to use, we should bear in mind that

- Nuclear issues are not uppermost in most people's minds.
- But they may become so, especially in a local community, if we are about to implement a policy which they had no part in formulating.
- So we should actively involve people from the beginning, and show how their views are taken into account.
- Many people do not know much about nuclear waste, or the organisations and issues involved.
- But they do have strong views about things that affect the environment and public safety.
- So we should provide clear information, and help people to see both sides of a debate.
- And we should learn from what others have done, in the UK and abroad.

Techniques for Engaging the Public

5.7 Techniques can be loosely divided into two groups: those that involve small numbers of people in intense deliberation, and those that involve larger numbers of people, generally with less opportunity for them to consider the evidence. We expect that a strategy combining both types of technique will best meet the need to involve a large and diverse group of people.

WORKSHOPS

5.8 Workshops provide an environment where small groups of people can get together with experts to discuss the issues involved in a particular topic. Because of their intimate nature, participants at workshops have the opportunity to explore the issues thoroughly, although the number of people who can join in is limited.

INTERACTIVE PANELS

5.9 Interactive panels have a standing membership that meets regularly to deliberate on issues. Health panels provide the main example in the UK – Somerset Health Authority has been undertaking Health panels since 1993. Typically, there are 12 members of the public who meet around three times a year or so to discuss topics set by the commissioning body. There is a regular turnover of membership to stop the panels stagnating. At the end of meetings, members vote on each issue being discussed, and a report is then prepared by the researchers/facilitators for the commissioning body.

COMMUNITY ADVISORY COMMITTEES

5.10 Community Advisory Committees are groups of people who represent a particular community and its interests. They meet regularly with the experts to feed in the views of that community. Typically, Community Advisory Committees are usually set up to discuss projects that have been earmarked for specific localities rather than general policy issues.

CITIZENS' JURIES

5.11 Citizens' juries are groups of 10-12 people recruited by a commissioning body to represent a particular community. They form a 'Jury' who are given as much background information as possible before cross-examining the experts. The Jury then presents its findings in the form of a report to the commissioning body. The commissioning body are then obliged to publicise the report. Citizens' Juries are a highly interactive method of involving people in a complex issue, but the number of people who can participate is strictly limited.

CONSENSUS CONFERENCES

5.12 A Consensus Conference is similar to a Citizens' Jury except that the cross-examination of experts takes place at a public venue, where anyone can turn up and ask questions. This partially overcomes the problem of limited participation, although those that do turn up on the day tend to be those already familiar with the issues rather than members of the public with no prior interest.

STAKEHOLDER DIALOGUES

5.13 A stakeholder dialogue is a managed process that seeks to find common ground between different interest groups in a dispute, and aims to develop the understanding of both parties. The interest groups are brought together by a third party to discuss the issues associated with a particular topic and try to uncover what lies behind their different positions. Stakeholder dialogues help build more positive relationships between interest groups but do not directly involve members of the public.

LOCAL AGENDA 21 GROUPS

5.14 The majority of local authorities have Local Agenda 21 (LA21) processes in place, working on local action plans that work towards global sustainable development. LA21 is led by the local authority with the emphasis on involvement and participation by the local community. Partnership with other agencies at a local level is also important to LA21, as is the involvement of all sections of the community, for instance businesses, statutory organisations, academic institutions, faith groups, women's and youth groups. LA21 focuses on local issues but treats them in the long-term and global context. For communities where radioactive waste management is a local issue, LA21 will provide an existing process to plug into for giving people information and involvement in decision-making. Under new legislation local authorities now have to prepare strategies to promote community well-being. These new Community Strategies will be vehicles for sustainable development at local level, and should provide similar processes for engaging the public as LA21.

REGIONAL SUSTAINABLE DEVELOPMENT FRAMEWORKS

5.15 All English regions have, or are producing, a sustainable development framework. These set out a high level vision for sustainable development in the region as a point of reference for other plans (like Regional Planning Guidance or the Regional Development Agency strategies), and policies, and are agreed by the regional chambers. The production of a framework involves a wide range of regional stakeholders from business, the community, public services, and interest groups. The framework process in each region will have set in motion an ongoing process of consultation and debate which, as with LA21 and Community Strategies, can be plugged into; in this case to access major regional stakeholders.

ECONOMIC VALUATION TECHNIQUES

5.16 A variety of economic valuation techniques could be used to measure people's preferences towards different options. Such techniques would use market information and data from specially designed public surveys to assess the degree to which people are concerned about the risks posed to current and future generations and the environment by the different waste management options.

PUBLIC MEETINGS

5.17 Public meetings usually take the form of a question and answer session to which any member of the public can turn up. The aim is to address large numbers of people at the same time, although experience suggests that they sometimes become dominated by small groups of vocal individuals.

PUBLIC HEARINGS AND INQUIRIES

5.18 Public hearings and inquiries typically provide formalised, judicial style proceedings where projects and issues are subject to rigorous scrutiny from interested parties. However, because the outcome of a hearing or inquiry offers participants the opportunity to 'win' their case, they encourage adversarial stances rather than constructive debate.

OPEN HOUSES

5.19 Open houses are places where the public can look at displays that explain the issues surrounding a topic. The displays encourage the public to ask questions and discuss issues with experts who are present throughout the day. After seeing the displays and talking through the issues, people are often asked to put their views in writing. However, this method relies upon people being sufficiently motivated to attend the open house in the first place.

DELIBERATIVE OPINION POLLS

5.20 An ordinary opinion poll reflects the public's views on subjects about which they might know little. A deliberative poll examines what they think after they have had the time and information to consider the matter more closely. Typically, 250-500 participants are recruited as a representative sample. Their initial views on the issue under discussion are recorded. They are then provided with background material and, in smaller groups, have the opportunity to identify questions to put to the experts in plenary discussion groups. Final views are then recorded, and any changes in opinion measured and incorporated in a report for the commissioning body.

RESEARCH PANELS

5.21 A research panel is a large representative sample of between 500-5,000 people used as a sounding board by a public sector organisation. The panel has a standing membership but, to avoid stagnation, a proportion is replaced regularly. The panel is then asked about different issues over a period of time. Various examples of the research panel already exist in the UK, including the Cabinet Office's People's Panel.

5.22 In recognition of the need to listen to, and learn from, people's views, the Cabinet Office set up the Panel in 1998. It consists of 5,000 members of the public randomly selected from across the UK, and is designed to be a representative cross-section of the population (by gender, age, background, region, etc). Panel members are consulted about how public services are delivered and how that delivery can be improved from the point of view of the user. By listening to, and learning from, people's views, the Government will be better able to provide the services that people want.

5.23 The Panel provides three main channels for obtaining the views of the public: telephone surveys, face-to-face interviews and postal surveys, and five means of creating a dialogue where issues can be explored in greater detail: focus groups, workshops, in-depth interviews, citizens' juries and deliberative polls.

THE INTERNET

5.24 The internet is becoming an important forum for debate and communication. Large amounts of background information can be posted onto a website for any member of the public to access, and chat rooms provided to allow people to post any comments they may have.

5.25 ***Views are invited on the suitability of these or any other consultation techniques for engaging the public in the radioactive waste management debate.***

Existing Initiatives

5.26 We note that during the period between the 1997 Sellafield decision and the publication of this paper, some of the innovative consultation techniques have already been used to involve people in the radioactive waste management debate.

UK CEED CONSENSUS CONFERENCE ON RADIOACTIVE WASTE MANAGEMENT

5.27 On 21-24 May 1999, the UK Centre for Economic and Environmental Development (UK CEED) hosted a national consensus conference on radioactive waste management. The aims of the Conference were to:

- Contribute the views of informed citizens to the policy-making process;
- Gain an appreciation of the way in which the issues are framed and prioritised by the public;
- Identify key issues of concern as seen by the public and to recommend a process by which they might be examined and resolved;
- Expand the availability of reliable and high quality information to the public; and
- Stimulate wider and better informed public debate on the issue.

5.28 Recruitment of a Citizens' Panel was undertaken by an independent market research company using random selection techniques. The Panel were then given some background material before attending two preparatory weekends where they received further information, formulated questions and chose which experts they wished to cross-examine.

5.29 At the Consensus Conference itself, each expert gave a five-minute presentation. The panel then questioned the expert, followed by further discussion and debate. Members of the audience were able to submit written questions for consideration by the Panel. The Panel then retired behind closed doors to write a report on their conclusions and recommendations, based on the information they received during the process and from the discussion and debate at the Conference itself. Copies of the report were presented on the final day to the audience and the Panel answered questions from the audience and the media.

5.30 The Panel's overall conclusions were well-received and have been fully taken into account in the drawing up of this consultation paper. A complete list of the Panel's overall conclusions is attached at Appendix 2.

BNFL NATIONAL DIALOGUE

5.31 To inform their decision-making on the improvement of their environmental performance in the context of their overall development, BNFL invited the independent charity The Environment Council to facilitate a Stakeholder Dialogue process.

5.32 The BNFL National Dialogue involves a wide range of organisations and individuals interested in or concerned about nuclear issues. These include members of the community, environmental interest groups, regulators, Government Departments and BNFL's UK customers. The first meeting was held in September 1998 to identify and prioritise a list of issues and concerns to be addressed in future meetings. In December 1998, a smaller Task Group drawn from a range of organisations recommended that the Dialogue first address issues associated with waste management and discharges. In March 1999 the Waste Working Group and the Discharges Working Group were formed and issued with draft terms of reference by the Main Group.

5.33 The interim reports of the Waste and Discharges Working Groups were published on 28 February 2000. These interim reports are "work in progress" and clearly outline where the stakeholders in the Dialogue agree and disagree on the two subjects. The recommendations of the Waste Working Group are set out in Appendix 3. New working groups on the Spent Fuel Management and Plutonium are now up and running.

HSE STUDY

5.34 HSE hired Simpson Carpenter Ltd to conduct four focus groups (each with six to eight members of the public) in London and Manchester, and one thousand telephone interviews. The groups met in September 1999 and the interviews were held between February and March 2000. HSE presented a summary of its finding at the Institution of Nuclear Engineers' 'Conference 2000'. The aims of the work were to:

- Understand the key concerns people have about radioactive waste management;
- Explore the nature and extent of the concerns;
- Gain understanding of how waste is perceived in terms of risk, and to assess tolerability to risk;
- Ascertain perceptions of how the waste management industry is controlled; and
- Assess how well informed people feel.

5.35 The main findings of the study were that:

- Radioactive waste is not an issue at the top of most people's minds;
- People want more information;
- Attitudes and associations towards the nuclear industry are generally negative;
- People are generally in favour of current decommissioning plans;
- There is a degree of confidence in the current waste management strategies; and
- Regulators must have the power to exercise control over industry and be seen to use this power.

NIREX'S CONSULTATION PROCESSES

5.36 Between April and May 2000 The Future Foundation conducted 8 focus groups, (with 6-8 members of the public) 3 in London, 2 in Newcastle, 1 in Manchester and 2 in Edinburgh. They also conducted 1,035 face to face interviews with people with various demographic details in August 2000. The aims of the research were:

- To obtain a benchmark of awareness levels about Nirex and the issue of radioactive waste management;
- To obtain input to the design of future communication initiatives;
- To identify issues and concerns that people have about waste management; and
- To identify information requirements and guidance about its production.

5.37 The Centre for the Study of Environmental Change at Lancaster University conducted 11 focus groups around the country between July and October 2000 to identify issues and concerns that the public have in relation to radioactive waste management.

5.38 The initial results of the two pieces of work show that:

- People can, will and want to engage with the issue of radioactive waste management. This includes engaging with the ethical debate. To facilitate this Nirex and others need to:
- Provide information in a neutral form outlining the pros and cons and including various people's opinions;
- Use proactive techniques to allow access and space for people to discuss the issues;
- Demonstrate how people's opinions have been taken into account;
- The best way forward is to involve people in the debate from the beginning and take their opinions into consideration;
- Some people have negative associations with the word "nuclear" and do not distinguish between nuclear, radiation, bombs and waste. There is some confusion about the issues; and
- Most people are not familiar with current institutional arrangements, but seem to want an independent, inclusive body overseeing radioactive waste management, operating openly.

5.39 ***Views are invited on how the Government and the Devolved Administrations could build on these existing initiatives or develop any of the other techniques for engaging the public.***

APPLYING TECHNIQUES TO THE CURRENT CONSULTATION PROCESS

5.40 The UK Government and the devolved administrations believe that there is scope for using some of these consultation techniques to add to the value of the current exercise, and will therefore be:

- Running an interactive discussion forum on the internet at http://www.ukonline.gov.uk/online/ukonline/home
- Inviting members of the BNFL stakeholder dialogue in the debate to produce a joint response to the consultation paper, in addition to their individual responses.
- Organising research to contribute the views of members of the public to the consultation.

5.41 Additionally, we are also keen to see other innovative consultation techniques tried out, and would particularly welcome the results from any of these new methods that the stakeholder groups or Nirex (the Company currently charged with developing a disposal route for ILW) would wish to explore.

5.42 The results from these new methods of consultation will be considered alongside all other responses to the consultation.

CHAPTER 6

Managing the Debate

Summary

6.1 This Chapter describes the arrangements we expect will be required for providing independent, authoritative advice on research requirements. It also considers the arrangements required to undertake that research and, once policy decisions have been taken, for implementing a long term radioactive waste management policy.

Information Needs

6.2 We recognise that whichever methods are chosen to engage the public in the debate over managing radioactive waste, the process will only work if the information given to the public is accepted as accurate, objective and complete by all interested parties.

6.3 The Government and the Devolved Administrations, therefore, propose appointing an independent and authoritative body to advise on what that information is, where further information is needed, and when enough information has been gathered for decisions to be taken. This body would need to have the breadth of experience and knowledge to give its views widespread respect, and sufficient independence from Government and the waste producers for its deliberations to be considered objective. We would expect that all advice provided by this body would be put into the public domain.

Box 8: Current Knowledge of Management Options

6.4 To start the process of identifying information needs, DEFRA has launched a research project to provide a broad-brush view of current knowledge about long-term management options for long-lived radioactive wastes. The conclusions reached will provide a benchmark to help any independent advisory body set up after this consultation to decide where further research is needed.

6.5 The project will run alongside this consultation process and will rule out no options initially and will identify the widest range of waste management options possible within international law. It will determine:

- The information which will be required later in order to select with confidence practical options for managing radioactive wastes;
- Where that detailed information is lacking or imprecise;
- What future studies might be required; and
- How important is the information that, because of the very long timescales involved with some wastes, may never be known.

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6.6 To monitor and review the progress of the project, a Steering Group comprising about 20 members including representatives of the public, Government Departments, local authorities, NGOs and waste producers is being set up. The Steering Group will consider the reports of the consultant undertaking the research on behalf of DEFRA, and provide recommendations arising from the research project.

6.7 The specification for the research project is being made available on DEFRA's website with the issue of this Consultation Paper, and DEFRA expect that the conclusions of the research project will be put into the public domain next year alongside the response of the Government and the Devolved Administrations to the consultation exercise.

Advice and Research Management

6.8 The Government and the Devolved Administrations currently have available the Radioactive Waste Management Advisory Committee (RWMAC). RWMAC is a non-departmental public body set up in 1978. Its primary role is to advise on radioactive waste management topics. It also provides advice to bodies such as regulators, local authorities and other Government advisory committees. Members of RWMAC are appointed jointly by the UK Government (Secretary of State for Environment, Food and Rural Affairs) and the Devolved Administrations for one or two three-year terms. Currently, the 19 strong membership includes people with specialisms in nuclear and radioactive waste management, geology, radiological protection, environmental health, medical health, local government, environmental and societal perspectives, planning, and environmental law. Since 1991 RWMAC has routinely published individual reports on specific topics, and annual reports which provide a compendium of the year's work and set out the Committee's future work programme. It may be that RWMAC would need to be modified to perform the role envisaged in this Consultation Paper, although new alternatives are not ruled out.

6.9 If a new advisory body is set up, we envisage that any further research which is required, might be co-ordinated by another organisation acting as a centre for research expertise on radioactive waste management issues. The actual research would probably be tendered on the "open" market to suitable research organisations. While this organisation would also need to demonstrate its authority and independence, we believe that, to be consistent with the polluter pays principle, its work should be financed by the waste producers, public and private. As noted earlier, the bulk of today's wastes are assigned to Government, thus Government, directly or indirectly, would be the main financier. The House of Lords report on nuclear waste management recommended that such work be funded from a levy on the nuclear industry.

6.10 ***Your views are invited on the practicalities of this approach or alternative arrangements for funding the work.***

6.11 A further option would be to combine the advisory and research roles discussed. This would provide a more integrated approach to advance of the knowledge required to develop policy. There are a number of organisations in existence, or which could be created, that would be able to fulfil one or both of these roles. Descriptions of some of these organisations are given below.

THE ROYAL SOCIETY

6.12 The Royal Society is an independent academy founded in 1660 to promote the natural and applied sciences. The Society has a dual role as the UK Academy of Science, acting nationally or internationally, and as the provider of a broad range of services for the scientific community in the national interest. The Society consists of over a thousand Fellows elected for their scientific achievements, and is governed by a Council headed by the President and Officers. The Society has been active for many years in public debate and the development of public policy on science and technology. The Society brings together the experience and knowledge of its Fellows to develop independent studies and submissions which inform Government, Parliament, universities, industry and other sectors. Reports emerging from these studies are usually published. To date it has never been actively involved in research management.

UK NIREX LTD

6.13 Currently, what little research management there is in the UK on the disposal of ILW is undertaken by the radioactive waste disposal company, Nirex (see Box 10 below), and funded, in proportion to the volume of wastes they produce, by the waste producers (mainly BNFL, British Energy and other Government organisations, UKAEA and MOD). We believe that if Nirex were to become the centre for independent research management expertise, its Board would need to be expanded to cover a wider range of interests than it does currently. Additionally, to reflect the need for a fully comprehensive policy, Nirex would have to consider a greater range of radioactive wastes. It would also need to lead research in to all options and not just disposal. Again, such research would probably be contracted out.

Box 10: Nirex

6.14 Nirex was formed in 1982 and incorporated as a private limited company – United Kingdom Nirex Ltd – in 1985, to provide radioactive waste disposal services. Nirex is financed and owned by the main waste producers BNFL, UKAEA and British Energy in proportion to the volumes of waste they produce. In addition, the MOD contributes to the funding of Nirex. The Secretary of State for Trade and Industry holds a 'golden share' in Nirex, which gives safeguard rights over aspects of the Company's business, and the right to appoint two directors to the Nirex Board. Last year, DTI appointed Sir Ken Jackson (General Secretary of the AEEU) and Professor Andy Blowers (Professor of Social Sciences at the Open University and member of RWMAC).

6.15 The shareholders also have the right to appoint external directors, such as representatives from NGOs or a local community, to the Board, provided nominations are agreed by all shareholders. Past external appointments have included the late Ray Buckton, the late Alex Ferry (Trade Union representatives) and Angela Rippon (Newsreader).

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6.16 During its search for a suitable site for an underground repository, Nirex developed a research programme that, despite some reservations, the Inspector at the RCF Inquiry considered "impressive"18. The Company also developed a role in providing 'letters of comfort' to the waste producers which assured them that the waste conditioning they were undertaking was consistent with its eventual long-term disposal in Nirex's proposed repository. Since the RCF decision in 1997, Nirex have scaled down their operations but retained a strong research base and an advisory role to industry on the conditioning and packaging of waste. In the interim period, before any new institutional arrangements are finalised, we expect Nirex to maintain these roles.

RESEARCH BOARD MODEL

6.17 In March 1997 the Department of the Environment, Transport and the Regions (DETR, now DEFRA) launched a research project to consider the research and development requirements for the disposal of high-level waste and spent fuel. The project ran from March 1997 to July 1999, and was undertaken by consultants under DETR management. A key objective was to achieve and maintain a consensus view on R&D requirements and strategy among a broad group of interested parties. The project was overseen by a Project Board comprising 12 representatives from the UK Government and the territorial departments (pre-devolution), the waste producers, the regulators, RWMAC and the Royal Society. We consider that a similar Board, expanded to include representatives from other organisations such as environmental organisations and local authorities, might also oversee the development of the wider research programme managed by DEFRA on behalf of the Government and the Devolved Administrations.

Box 9: An R&D Strategy for the Disposal of High Level Radioactive Waste and Spent Nuclear Fuel

6.18 In March 1997, when deep disposal was the preferred disposal option, the DETR launched a research project to develop a Research and Development (R&D) strategy to inform decisions on whether and, if so, how and when to proceed with any geological disposal programme for HLW and spent nuclear fuel. No decision has been made to undertake such a disposal programme. The main components of the strategy were the:

- Identification of the detailed technical elements of R&D that would be necessary to support a repository development programme;
- Establishment of the timescales over which this R&D would need to be carried out;
- Consideration of which areas of R&D might be best carried out in collaboration with other national and international programmes; and
- Examination of the likely disposition of responsibilities for the R&D elements among the broad organisational groupings of waste producers, programme implementers, and policy makers.

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> 6.19 The study concluded that although considerable R&D on the deep geological disposal option had been pursued over a period of almost 25 years, better understanding is required in some quite general areas. The project identified what these areas were, and developed suggestions for a strategy to see the work carried out. As such, and notwithstanding that no decision has been made to launch a disposal programme for high level waste, the project provides a useful basis for planning R&D activities.

RESEARCH INSTITUTE MODEL

6.20 Another option is to create an organisation that pulls together and builds upon existing expertise, such as that developing from work funded by the UK Research Councils. An organisation of this type (The Tyndall Centre for Climate Change Research) has already been set up by the Research Councils. The Centre performs interdisciplinary scientific research on climate change, drawing upon existing knowledge and expertise within the separate disciplines. It also provides a national centre for advice to stakeholders.

6.21 If, following this consultation, an organisation other than RWMAC is asked to provide independent advice to the Government and the Devolved Administrations, the Committee's advisory role may no longer be required, and it could be disbanded. However, in the interim period before any such body could take up this role, we would still be looking for RWMAC to provide high quality advice on the wide range of issues related to the management of all radioactive wastes.

A NUCLEAR WASTE MANAGEMENT COMMISSION

6.22 In its report on the Management of Nuclear Waste, the House of Lords Select Committee on Science and Technology proposed setting up an integrated organisation, the Nuclear Waste Management Commission, to make arrangements for research to be carried out and to oversee the implementation of policy. The proposal was that, initially, the Commission would be set up without legislation, with the task of holding discussions about a consultation paper covering a comprehensive policy for the management of all long-lived wastes, and undertaking any associated technical research and economic analyses. It would report its findings to the Government and the Devolved Administrations, which would use them in formulating the policy to be put to the UK Parliament and the devolved legislatures in the form of Bills for debate and decision.

6.23 The Bills would establish policy and give the Commission powers to ensure that the policy endorsed by the UK Parliament and the devolved legislatures was implemented. This role would include research management, undertaking consultation on means to implement policy, and providing information. The workings of the Commission would be as open as possible, with a presumption that everything it produced would be published.

6.24 Members of the Commission would be appointed by the Secretary of State for Environment, Food and Rural Affairs and the equivalent Ministers in the devolved administrations after appropriate consultation, and would be drawn from a wide range of backgrounds to ensure that no one point of view was dominant. The Commission's staff would include people qualified in the physical, biological and social sciences. The

Commission would report annually to the Secretary of State and the Devolved Administrations, who would place their reports before Parliament and the Devolved Bodies respectively. At appropriate intervals debates would be held on the Commission's reports to provide explicit Parliamentary / Assembly approval. The Commission would be responsible for co-ordinating all UK research on the long-term management of radioactive wastes.

6.25 ***Your views are invited on the need for an independent body to advise the Government and the Devolved Administrations on information needs and research requirements, and whether any of the organisations or models above would be able to provide the independent and authoritative advice and/or the research management we require. You are also invited, if you wish, to outline alternative arrangements for discharging these roles.***

Policy Implementation

6.26 When the Government and the Devolved Administrations have determined what policies should apply to the long term management of radioactive waste, there will be a requirement to put them into effect. There are a number of organisations in existence which might be responsible for implementation. Or new ones could be created.

NIREX

6.27 Nirex was first formed to construct and operate new land disposal facilities for LLW and ILW. Although Nirex have scaled down their operations following the RCF decision in 1997 it has retained the core skills and knowledge required to implement a disposal policy. However, such a policy may not be chosen, but Nirex has some skills related to the storage phase that was seen as preceding deep disposal. Nirex has time to build expertise to support other management options but if these involve processes on existing sites then the site operators might be the more logical organisations to use.

LIABILITIES MANAGEMENT AUTHORITY

6.28 As part of the current Quinquennial Review of the United Kingdom Atomic Energy Authority, options are being explored which include the creation of a new body responsible for the management of part of or all publicly funded civil nuclear liabilities. This includes decommissioning and the associated radioactive wastes, a liability that in total amounts to over £40 billion. If a single body on these lines were to be set up, its focus would be on developing and managing century-long strategies for the decommissioning of the liabilities for which it was responsible and the environmental restoration of the sites at which they are situated. Implementation would be carried out by third parties, either in the public or the private sectors. The single body would be responsible to Government which, in turn, would exercise control through a high level board appointed by and accountable to Ministers.

6.29 The long term management of waste is the biggest single element in the cost of dealing with nuclear liabilities. It follows that a body on these lines would

- have a direct interest in the implementation of decisions on waste management policy; and
- the management skills required to oversee the implementation of that policy on behalf of Government through one or more third parties from either the public or the private sectors.

6.30 Stage 2 of the Quinquennial Review is due to be completed shortly. An announcement about the outcome and any subsequent consultation will be made once Ministers have had an opportunity to consider the recommendations made.

THE RADIOACTIVE WASTE DISPOSAL COMPANY

6.31 The House of Lords Select Committee on Science and Technology, after taking evidence on a range of waste management options, recommended that the Government embark on a phased approach to geological disposal. If this recommendation were accepted, the Select Committee also recommended that a 'Radioactive Waste Disposal Company' should be set up. This would have the remit to investigate a small number of potential repository sites, to select the preferred site (or sites) and to design, construct, operate, monitor and eventually close the repository (or repositories), conducting R&D as necessary. We plan to go through a consultation process before defining policy and well before starting its implementation. So the question of setting up such a company does not arise at this stage.

6.32 It may take several years of debate and information gathering to reach a decision on a waste management strategy. We shall then be inviting comments on how it should best be implemented, including any organisational changes. It is too soon to seek views, at this first stage, on the merits of different organisations for that purpose. But you may like to be aware of some eventual possibilities.

CHAPTER 7

The Programme for Action

Summary

7.1 This Chapter looks at when decisions on the policy for managing radioactive wastes could be taken, and what arrangements will be required in the interim period before these decisions are made.

Generating Public Debate

7.2 The Government and the Devolved Administrations recognise that it will take a long time to identify and implement a management option for radioactive wastes that commands widespread support. We firmly believe that it will be important not to rush this process, but to take the time required to ensure that each step forward commands the widest possible public support. As wastes can continue to be stored safely in the medium term (50 years) using current technology, the timetable for the consideration and implementation of policy should be driven by the need to develop a clearer understanding of the safety and environmental issues associated with each potential option for the long term management of radioactive waste.

7.3 For illustrative purposes, we set out an indicative programme for action in the table below. However, all steps are subject to amendment in the light of responses to this consultation. The dates suggested are dependent upon the level of research required following the end of Stage One. Consequently, they can only be rough guides as to when future stages might begin.

Table 1: **A Programme for Action** (all timings are approximate)

Stage One	Consultation on techniques for public participation, scientific research and institutional arrangements for the interim period. (The document you are now reading.)	2001-2002
Stage Two	Research programme to examine the feasibility of the waste management options; and Preparation of the next (Stage three) consultation paper	2002- 2004
Stage Three	Further consultation paper on the feasibility of the waste management options.	2005
Stage Four	Announcement of our decision on the preferred waste management strategy, and further consultation on how to implement it.	2006
Stage Five (if required)	Legislation setting out how the management strategy is to be implemented.	2007

7.4 ***Views are invited on the indicative programme of action in Table 1***

7.5 Stage One is the consultation launched by this paper. As set out elsewhere within this document, views are being sought on a number of issues, in particular on consultation techniques, scientific research methods and the institutional arrangements for the interim period. Subsequent stages are dependent on the responses to this consultation. However, it is expected that Stage Two will be a research programme examining the strengths and weaknesses of the available management options. To provide a platform for this programme, DEFRA is launching a research project to run alongside this consultation exercise. This project will provide a benchmark for what information is already known about all potential management options. The research programme would draw on the results from this project to explore the feasibility of the management options in detail.

7.6 Stage three. When enough information is known about the management options to enable a decision to be taken about a comprehensive waste management strategy, it is anticipated that a further consultation would be launched. This would set out the strengths and weaknesses of the management options, and invite the public's views on the management strategy that should be adopted. If an independent advisory body is set up following this consultation exercise (see Chapter 6), we would look to it for advice about when this stage has been reached. It is, obviously, not possible to give a firm date for the end of the research programme but, based on previous experience investigating a strategy for the disposal of high level radioactive waste and spent fuel,[19] it may be anything up to 3 to 4 years away. Given that existing wastes can be safely stored for the next 50 years, we believe it is right not to give an artificial deadline for the research programme to end, but to allow the time required to explore the management options thoroughly.

7.7 Stages four and onwards. Subsequent steps would be dependent on the responses to the "Stage three" consultation, but would almost certainly involve a Government announcement setting out the preferred waste management strategy and inviting comments on how this should be implemented, e.g. if a site selection process is necessary, how it should be run. If required, this may then be followed by legislation setting out the implementation programme in law.

Storage of Wastes

7.8 During the interim period while policy is being developed and implemented, existing and future arisings of radioactive waste will be safely stored in accordance with regulatory requirements. We have noted the conclusions of the HSE in their review of radioactive waste storage in the UK, and fully expect nuclear licensees to take appropriate action where necessary to ensure these stores remain safe. The presumption should be that stores will need to last for at least 50 years. This will require the building of up to 20 stores for the wastes currently accumulated on all major licensed sites, which would be required in any case should an operating repository not be available by 2015.[20] Where wastes are held in a raw untreated state, whether as a result of historical arisings or current operations, these should be made passively safe, in a form that does not close down any long-term management options, as soon as practicable.

19 DETR "An R&D Strategy for the Disposal of High-Level Radioactive Waste and Spent Nuclear Fuel" (October 1999)

20 HM Nuclear Installations Inspectorate "Intermediate Level Radioactive Waste Storage in the UK: A Review" (November 1998)

Regulation

7.9 The House of Lords Select Committee on Science and Technology recommended that if their proposed Nuclear Waste Management Commission was set up, some changes should be made to regulatory arrangements[21]. They recommended that the Environment Agency should be given a new statutory power over the storage of wastes on nuclear licensed sites. The Select Committee's recommendation provides an opportunity to review the current arrangements for radioactive waste management.

OBJECTIVES OF REGULATION

7.10 Under any regulatory system, storage will continue to be needed for radioactive wastes until a final management strategy is available. In the case of solid wastes with more than low levels of radioactivity, the implementation of a final management strategy is unlikely to be complete for several decades. Wastes requiring storage pending the development of a final management strategy will need to be maintained under conditions of passive safety with minimal need for human intervention. Some wastes will need to be processed and packaged to achieve this.

7.11 An effective regulatory regime will achieve the following:

- Give proper emphasis to safety and long-term environmental considerations;
- Maintain containment of radioactivity and prevent leakage so that wastes can do no harm to people or the environment;
- Provide for any necessary steps to prevent unauthorised release of radioactivity into the environment to be taken promptly;
- Where waste needs to be packaged or treated to achieve passive safety, to ensure that this is done promptly;
- Provide assurance that processing and storage of wastes do not prejudice future waste management options;
- Provide adequate opportunities for consulting, and informing the public;
- Provide an appropriate balance between costs and benefits; and
- Ensure transparency in setting standards and in the regulatory processes.

CURRENT REGULATORY ARRANGEMENTS

7.12 Over 99% of radioactive wastes are on sites licensed under the Nuclear Installations Act 1965 (nuclear licensed sites). The HSE regulates radioactive waste management on these sites. The HSE may attach to site licences such conditions as it thinks fit with respect to the handling, treatment and disposal of nuclear matter – including radioactive waste.

21 House of Lords Session 1999-00 Third Report of the Select Committee on Science and Technology. "Science and Society" (February 2000)

7.13 HSE's inspectors are empowered to regulate within the field of responsibility of the Executive including the enforcement of nuclear site licence conditions. The standard required by nuclear site licence conditions is that there should be no leakage or escape of radioactive materials from stored waste unless it is authorised by the environment agencies. Therefore there should be no radiological impact on the environment from discharges that is not regulated by the agencies. All new stores are regulated to this standard, but some older stores do not fully comply. In some of these cases, wastes are being retrieved using remote handling techniques. In others, HSE are seeking improvements as discussed in its recent publications on intermediate[22] and high level[23] waste storage.

7.14 Agency inspectors are empowered to exercise their powers within the field of responsibility of the agencies. The agencies are responsible for regulating, under the Radioactive Substances Act 1993, routine disposals of all forms of radioactive wastes (solids, liquids and gases). However, on sites that HSE licenses, the agencies have no statutory powers over waste storage until the licensee seeks permission to dispose of the waste. On sites that are not licensed, such as hospitals and universities, the agencies regulate storage of radioactive wastes as well as disposals.

7.15 The HSE regulates the storage, conditioning and packaging of radioactive waste on nuclear licensed sites and the agencies only have statutory powers over disposal. However, HSE have a statutory requirement to consult the agencies on radioactive waste management issues before issuing, amending or varying nuclear site licenses, or attaching conditions to them relating to radioactive waste management. In addition to statutory consultation requirements, the HSE and Environment Agency have set down and jointly agreed their responsibilities and working arrangements on matters of mutual interest within a Memorandum of Understanding (MoU). The intention of the MoU is that the activities of the Agency and HSE in relation to licensed nuclear sites are consistent, co-ordinated and comprehensive. The possibility of conflicting requirements being placed on licensees, or others concerned, is eliminated, and duplication of activity is minimised. A similar MoU is under discussion between HSE and the Scottish Environment Protection Agency.

7.16 In practice, a nuclear site operator wishing to process or store radioactive wastes must first seek permission to do so from HSE. The MoUs provide for the agencies to be consulted on the licensee's proposals for construction, modification or decommissioning of plant. In accordance with the terms of the MoU, the HSE does not give the licensee permission to proceed with any proposal that has radioactive waste management implications unless the appropriate Agency has written to HSE to indicate its agreement.

OPTIONS FOR THE FUTURE

7.17 There are arguments for and against change to the current regulatory arrangements for radioactive waste management on nuclear sites.

22 HM Nuclear Installations Inspectorate "Intermediate Level Radioactive Waste Storage in the UK: A Review" (November 1998)

23 HM Nuclear Installations Inspectorate "The Storage of High-Level Waste at Sellafield – an Updated Review of Safety" (February 2000)

7.18 One view is that the arrangements described above are incomplete and may not be appropriate to today's needs. In particular, the agencies cannot directly require a site licensee to provide the information they need to judge the environmental impact of the storage and ultimate final management of waste. Nor can they set regulatory requirements. If the environment agencies were given a new statutory power over the storage of wastes, nuclear licensees would need to provide the relevant information to the agencies in order to obtain authorisations for storing wastes. Such authorisations would be issued subject to certain conditions, and could require improvements to be made in storage arrangements. The purpose of the new power would thus be to provide greater assurance that processing and storage of waste does not prejudice future management options, and that licensees give increased emphasis to long-term environmental considerations, including the possibility of environmental impact from stored wastes, alongside the requirements of operational safety. The authorisation process would also give additional opportunities for consulting, and providing information to, the public.

7.19 The alternative view, is that there is no evidence that the current regime fails to provide effective regulation, nor that a statutory power for the agencies would enhance it. Dual regulation could face licensees with conflicting and unresolved statutory requirements. The existing arrangements provide positive advantages, including a robust and complete regime for the protection of workers, the public and the environment. They also ensure that the agencies are fully involved in matters affecting radioactive waste management, and full consultation by HSE on regulation of radioactive waste storage will provide sufficient opportunity for the views of the public to be taken into account.

7.20 ***Views are invited on the whether the Environment Agency in England and Wales, and the Scottish Environment Protection Agency in Scotland require a new statutory power over the storage of wastes on nuclear licensed sites.***

Regulatory Impact Assessment

7.21 A Regulatory Impact Assessment (RIA) is a short structured document published with regulatory proposals and new legislation. It is intended to ensure that any regulation is necessary, aimed at the right target, and in proportion to the problem or issue being addressed. At this stage in the consultative process, where the UK Government and the Devolved Administrations are mainly seeking views on procedural issues, an RIA is not considered necessary. However, it is expected that the next consultation paper at "Stage two" (see Table 1 above), will contain a detailed RIA for any regulatory proposals.

CHAPTER 8

Conclusions

Summary

8.1 This Chapter describes the main proposals in the consultation paper, lists the issues on which your views are invited, and summarises the way forward envisaged by the Government and the Devolved Administrations.

The Aim of the Consultation

8.2 This consultation paper begins the process that will ultimately lead to the implementation of a radioactive waste management policy capable of commanding widespread support across the UK.

A Public Debate

8.3 The Government and the Devolved Administrations believe that this support can only be obtained following public debate on the issues associated with the management of radioactive waste. This debate must involve as many people as possible, but at the same time it should not simplify the issues to a level where they become meaningless. To achieve both of these goals, we believe it will be necessary to use some of the new and innovative consultation methods that generate strong public involvement. **Your views are invited on the techniques that should be used.** (Chapter 5, paragraphs 5.25 and 5.39)

Informing the Debate

8.4 We recognise that whichever methods are chosen to engage the public in the debate over managing radioactive waste, the process will only work if the information given to the public is accepted as accurate, objective and complete by all interested parties. We propose appointing an independent and authoritative body to advise on what that information is, where further information is needed, and when enough information has been gathered for decisions to be taken. **Your views are invited on the formation of a new advisory body and its funding.** (Chapter 6, paragraph 6.10)

8.5 Further research could be co-ordinated by another organisation. This would act as a centre for research expertise on radioactive waste management issues. While this organisation would also need to demonstrate its authority and independence it work would be financed by the waste producers. Alternatively, the advisory and research roles could be combined under one body. **Your views are invited on this, and on which type of organisation could take on this co-ordination role.** (Chapter 6, paragraph 6.25)

The Programme for Action

8.6 We firmly believe that the process for identifying and implementing a strategy for managing radioactive wastes must not be rushed. It will be important to take the time required to ensure that each step forward commands the widest possible public support.

8.7 During the interim period while policy is being developed and implemented, existing and future arisings of radioactive waste will be safely stored in accordance with regulatory requirements. The presumption should be that existing stores will need to last for at least 50 years. Where wastes are held in a raw, untreated state, whether as a result of historical arisings or current operations, these should be made passively safe as soon as practicable, in a form that does not close down any long-term management options. **Your views are invited on this programme for action, and the regulatory arrangements required to implement it.** (Chapter 7, paragraph 7.20)

Other Issues

8.8 The consultation paper is not just about the process by which decisions will be reached. **We would also welcome your views on a number of important radioactive waste management issues:**

- **The principle of segregating UK waste types by half-lives** (Chapter 2, paragraph 2.17)
- **RWMAC's proposals for the management of spent sealed sources** (Chapter 2, paragraph 2.41)
- **The link between waste substitution and the availability of a repository or other facility** (Chapter 3, paragraph 3.14)
- **The general approach to decommissioning** (Chapter 3, paragraph 3.33)
- **The policy to be adopted for the long-term management of separated plutonium, including whether some proportion of the UK stockpile should be considered waste** (Chapter 3, paragraph 3.46)
- **The policy to be adopted for the long-term management of uranium, including whether some proportion should now be considered waste** (Chapter 3, paragraph 3.57)

And we would welcome any other comments on the content of this paper, including any other options for the management of radioactive waste that you think should be considered.

APPENDIX 1

Options for the Long-Term Management of Radioactive Waste

Summary

1. This Appendix summarises the main options for the long-term management of radioactive wastes. All of these options are under consideration by Government, except where they have been ruled out by international agreements or treaties.

2. This consultation does not involve choosing a management option. The timetable for taking this decision is set out elsewhere in the paper. At the current time, we are only setting out which options could be considered further.

Above Ground Storage

3. In the absence of a final management policy, ILW and HLW are both stored safely above ground until a solution is adopted. However, storage could also be utilised as a longer-term solution. This would allow future generations some flexibility in deciding what to do with the radioactive waste legacy, and allow them to take advantage of any future scientific or technical advances – although once wastes have been conditioned they are less amenable to alteration.

4. However, there are a number of disadvantages. Permanent surface storage places a radiological burden on future generations. In anticipation of early disposal, current stores and waste packages were designed to last for only several decades. Storage for a considerably longer period (over 50 years) will place demands on both structures and packaging. Human intervention, involving risks to workers, would be necessary to relocate the wastes to an alternative site, or to prepare the wastes for repackaging or reconditioning.

Underground Disposal

5. A sealed underground disposal facility for ILW and HLW would isolate radioactive wastes from the environment without having to rely on the actions of future generations. A report by the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD)[24] suggests that this is the preferred option in most member countries (see also Appendix 4 for more information on individual countries' experience inside and outside the OECD).

24 Nuclear Energy Agency "Geological Disposal of Radioactive Waste: Review of Developments in the Last Decade." (1999)

6. However, underground disposal would preclude the possibility of future generations utilising any scientific or technological advances. In addition, at the 1997 Inquiry into the Rock Characterisation Facility (RCF) at Sellafield, the Planning Inspector voiced concerns about how long radioactivity could be isolated in a repository before groundwater brought it back into the environment[25].

Underground Storage

7. Theoretically, it should be possible to combine the deep disposal option with built-in retrievability to create underground stores that have some of the advantages of storage and disposal. Within these stores, radioactive waste could be monitored and either retrieved by future generations or sealed in to create a permanent disposal facility.

8. However, at present the feasibility of building such stores has not been fully tested, and the cost of storage is increased without the additional benefit of isolation from the surface environment.

Partitioning and Transmutation

9. It has been suggested that partitioning and transmutation (P&T) could reduce the inventory of long-lived radioactive wastes. Partitioning is the separation of long-lived radionuclides from wastes (usually by chemical means) and transmutation is the transforming of these radionuclides into shorter-lived or stable nuclides in a reactor or using a particle accelerator. While this is conceptually attractive there are some practical difficulties:

- It is only a partial solution, as it is limited to radionuclides that can both be easily partitioned (separated) from other wastes, and that are amenable to transmutation. Hence, some long-lived radionuclides will require an alternative waste management option;

- The technology is still being developed, and it may be many years before feasibility can be demonstrated on an industrial scale;

- Adoption of P&T would imply an extension of reprocessing, and the construction of new facilities for the fabrication of targets for transmutation, and reactors or accelerators to undertake the transmutation. Additional plants would eventually require decommissioning and secondary wastes would be generated; and

- All these activities would require handling, and could lead to increased doses to workers.

10. In some countries P&T is only seen as applicable if a new phase of nuclear power production were to occur. Alternatively it has been proposed as a solution to dealing with redundant military plutonium from nuclear weapons in Russia and the USA. The UK carried out several studies in the late 1970s and early 1980s, but there are currently no plans to resurrect a research programme into P&T. However, the UK Government continues to monitor research being carried out in the United States, France, Japan, and as part of the European Commission's research programme.

25 Government Office for the North West "Secretary of State Dismissal of the RCF Appeal" (March 1997)

Disposal at Sea

11. Disposal at sea has been used in the past, but is now ruled out by the UK's obligations under the London Convention and the Convention for the Protection of the North-East Atlantic (OSPAR). At the September 1997 meeting of the OSPAR Commission the UK Government announced its decision to give up its potential opt-out on sea dumping of low and intermediate-level radioactive waste.

Sub-Seabed Disposal

12. Disposal in empty offshore oil and gas fields has also been proposed for high level wastes. However, as the UK has ratified the 1996 London Convention Protocol, which extends the definition of sea dumping to include storage of waste in the seabed, it is also ruled out by the UK's obligations under the London Convention and OSPAR.

Outer Space

13. Disposal of radioactive wastes in outer space is generally considered unacceptable because of the large number of rocket launches that would be needed, and the potential catastrophic consequences of a launch failure.

Subduction Zones

14. Subduction zones are areas where a geological plate is driven towards the earth's core by collision with another plate – as occurs off the west coast of the American continent. Disposal of wastes in subduction zones is considered unacceptable because of the lack of certainty about the fate of the wastes.

Ice Sheets

15. Disposal of high level wastes under the polar ice caps is also considered unacceptable because of the lack of confidence in the eventual fate of these wastes. Disposal in Antarctica is in any case now ruled out by the UK's obligations under the Antarctic Treaty.

APPENDIX 2

The UK CEED Consensus Conference on Radioactive Waste Management

Overall Conclusions

1. Radioactive waste must be removed from the surface and stored underground, but must be monitorable and retrievable. Cost cannot be an issue. We must leave options open for future solutions.

2. We recommend the appointment of a neutral body by the Government to deal with waste management, including the selection of a national storage site. The criteria for site selection should be open and publicised.

3. All institutions handling radioactive waste should conform to the same high standards which should include random scrutiny.

4. Research and development must be continued on a much larger scale and international co-operation should be encouraged.

5. We see no problem with privatisation within the nuclear industry if done properly with adequate safeguards.

6. At present there is a lack of trust and understanding and public awareness must be raised. The public needs to be fully informed of the problems and solutions available. Decision-making must be open and transparent. Radioactive waste issues should be made part of the Government's education strategy.

7. We are not fundamentally opposed to nuclear power, but it should not be expanded until a way is found to deal adequately with the waste problem.

8. A new and internationally accepted method of waste classification is needed that clearly and openly communicates information about nuclear waste to the public as well as industry.

9. Existing international reprocessing contracts should be honoured but no new ones should be taken up.

10. Finally, while the industry has in the past had a well-deserved reputation for secrecy, we have in the course of the conference noted a welcome shift in culture and a new feeling of openness in dealing with these difficult issues.

Membership of the Panel

11. The members of the Citizens' Panel were:

- Mary Allan, Ross-shire, Scotland.
- Ted Bowen, Shropshire.
- Carole Dancox, Lancashire.
- David Denham-Smith, Norfolk.
- Anna Hiett, Wiltshire.
- Ben Humphries, Buckinghamshire.
- Colin Hunter, Norfolk.
- John Paxton, Tyne and Wear.
- Pam Phillipou, South Glamorgan.
- Elisabeth Prescott, Merseyside.
- Jake Rolfe, Wiltshire.
- Christine Talbot, Hertfordshire.
- Trystan Tavener, Nottinghamshire.
- Chris Thomas, West Yorkshire.
- Derek Windsor, Cambridgeshire.

APPENDIX 3

The Waste Working Group from the BNFL National Dialogue

Recommendations and Suggestions for Future Work

1. The Waste Working Group urges all stakeholders party to the dialogue process to accept the following principles, statements and positions, and to use these to inform and refine the task of making a final set of recommendations to the company through which it can improve its environmental performance.

   - All existing waste arisings must be packaged in passively safe, monitorable and retrievable interim storage in the shortest possible time.

   - Subject to satisfactory performance and safety review, interim storage offers a feasible management option for 50 years and beyond but research must continue into long term storage and the possibility of disposal. The Company cannot rely solely on others: it must be actively involved in research.

   - Within the next 50 years existing and future planning and regulatory controls will make it necessary to periodically revisit the adequacy of interim stores as consents expire, control regimes are improved or alters or as waste management policy is redefined. The opportunity to revisit research, advancing technology, waste minimisation and compaction, against the background of changing values must be accepted.

   - The Company must continue to successfully embrace change. The nine scenarios developed by the Waste Working Group provide a framework within which strategic options can be considered objectively. The scenarios should therefore be adopted and used in all research and analysis conducted in connection with the BNFL Stakeholder Dialogue.

Waste Working Group Membership

2. The organisations represented on the Waste Working Group were:

   - British Energy (BE)

   - British Nuclear Fuels (BNFL)

- British Nuclear Industry Forum
- Campaign for Nuclear Disarmament
- Copeland Borough Council
- European Commission
- Friends of the Earth
- General and Municipal Boilermakers Trade Union
- Health and Safety Executive's Nuclear Installations Inspectorate
- Pete Wilkinson Environmental Consultancy
- UK Nuclear Free Local Authorities
- Westlakes Research Institute

Background

3. Participation (by organisation or individuals) in either the overall dialogue or the working group must not be taken as an indication of support or disagreement with the dialogue itself, its outputs or BNFL's activities.

4. The report from the Waste Working Group must be read carefully. The working group has been very careful to outline where they agree and disagree and they have tried to be as explicit as possible.

5. It is an interim report, which indicates areas needing further work. Its principle purpose is to inform the deliberations of the Main Group of stakeholders in the dialogue and any related decisions or activities they might undertake. It is important to note that these are, therefore, interim reports to the Main Group of stakeholders in the dialogue.

6. Nothing can or should be inferred from the reports about the views of Main Group stakeholders on their contents, except where these views have been made explicit and appended to the reports.

Main Group Membership

7. The organisations and individuals represented on the Main Group of stakeholders (as at November 1999) were:

- Amalgamated Engineering and Electrical Union (AEEU)
- British Energy
- British Nuclear Fuels plc (BNFL)

- Campaign for Nuclear Disarmament (CND)
- CND Cumbria
- CND Cymru
- CND West Midlands
- Cricklewood Against Nuclear Trains
- Cumbria County Council
- Cumbrians Opposed to a Radioactive Environment (CORE)
- Department of the Environment, Transport and the Regions (DETR)
- Department for Trade and Industry (DTI)
- Environment Agency
- Ethics etc.
- Dr David Lowry, freelance environmental policy and research consultant
- Friends of the Earth
- Friends of the Earth Cumbria
- General and Municipal Boiler Makers Union (GMB)
- Green Party
- Greenpeace International
- Greenpeace UK
- IMD, International Institute for Management Development
- IMPACTT
- Imperial College
- Mr Mike Sadnicki, independent economist
- Institute for Resource and Security Studies
- Institution of Professional Managers and Specialists (IPMS)
- Kommunenes Internastonale Miljøorganisaston – Local Authorities International Environmental Organisation (KIMO)

- Lancashire County Council
- Ministry of Agriculture, Fisheries and Food (MAFF)
- Marine Forum for Environmental Issues
- Nuclear Awareness Group
- Nuclear Control Institute
- Nuclear Installations Inspectorate (NII)
- Mr Fred Barker, nuclear policy analyst
- Oxford Research Group
- Radiological Protection Institute of Ireland
- Radioactive Waste Management Advisory Committee (RWMAC)
- Scottish Environmental Protection Agency (SEPA)
- South Cleveland Hospital
- Transport and General Workers Union (TGWU)
- UCATT, Building Workers Union
- UK Nuclear Free Local Authorities
- Welsh Anti-Nuclear Alliance
- Westlakes Research Institute
- Westlakes Scientific Consulting
- Wilkinson Environmental Consulting
- WS Atkins

APPENDIX 4

Radioactive Waste Management Policy in Other Countries

Summary

1. This Appendix summarises policy for the management of radioactive wastes in a range of other countries. The Government and the Devolved Administrations are monitoring developments in other countries and will draw on international experience as radioactive waste management policy develops.

2. This is mainly intended for the general reader rather than the specialist. It aims to give a general background on some of the main issues and problems faced in other countries, and how these are trying to tackle them.

Belgium

3. Radioactive waste in Belgium is classified as Categories A, B and C. The classification is not directly comparable with that for the UK, but covers the complete range of equivalent UK wastes. The quantities of waste total about 70,500m^3 (60,000 m^3 of category A waste and 10,500 m^3 of categories B and C waste). This estimation is based on the complete dismantling of each of the seven Belgian nuclear reactors after forty years of operation.

4. The current waste management policy is:

   - Completing an inventory of the waste equivalent to VLLW, in order to determine the future waste management policy.

   - Storage for waste equivalent to LLW and short-lived ILW (category A) pending development of a disposal facility, which may be near surface or deep.

   - Storage for waste equivalent to HLW and long-lived ILW (categories B and C) pending development of a deep repository (for which clay is being investigated as a potential host rock).

5. Until 1996 the organisation responsible for waste disposal applied a site selection approach purely based on technical criteria for the siting of a near-surface facility for LLW. The failure of this approach (all the local councils with potential sites rejected hosting such a facility) led to a drastic change in the decision making process. After a governmental decision in January 1998 the waste organisation was instructed to limit site characterisation activities to existing nuclear sites or to sites in volunteering municipalities, and also to develop methods, including management and dialogue structures, necessary to integrate a repository project at the local level

6. Progress on the development of a deep repository has been steady. A site beneath a major nuclear research centre has been the focus of research since 1974. A clay formation at some 220 metres depth is studied in the current methodological R&D programme. In this phase of the programme no site selection decision has yet been taken. Disposal of category B and C radioactive waste is not foreseen before 2035 (category B) and 2050 (category C). A similar, but slightly older clay formation below another nuclear site is also currently under examination.

7. Following the unsuccessful attempt to site a near-surface facility for LLW, as noted above, the waste organisation has since 1998 concentrated its activities on the development of local "**partnerships**" to facilitate project proposals in areas where interest in hosting a disposal facility has been expressed. In two communities (with existing nuclear facilities) a local partnership was established between the waste organisation and the local authorities and local public. These partnerships are intended to bring the decision making process closer to the public concerned and to lower the threshold for active participation. The final outcome of this decision making exercise is therefore a mutual project, undertaken by both experts and local stakeholders, instead of an expert project imposed on an unwilling community. The partnerships will report to the Government by 2003, in view of obtaining a decision on which disposal project should be continued.

8. Due to the fact that for the disposal of category B and C waste the R & D programme is still at the stage of the "generic" research (host rock specific but not site specific) to date there has been no concentrated effort on public involvement. A report providing state-of-the-art information on the methodological R&D phase and presenting recommendations for the next phase of the programme is due for submission by the end of 2001. An accompanying decision-aiding document will address potential approaches for stakeholder dialogue on the long term management of high-level waste and long-lived intermediate-level waste in Belgium.

Canada

9. As regards VLLW/LLW and ILW, Canada makes a distinction between 'current' arisings and 'historic' wastes from past uranium milling activities. Nuclear fuel waste is not reprocessed and around 65,000 tonnes (14, 470m^3) will require management by 2035.

10. The present waste management policy envisages:

- Disposal of wastes equivalent to VLLW.
- In situ decommissioning of uranium mine and mill tailings.
- Long-term management of 'historic' wastes in above ground engineered mounds located at existing storage sites.
- Storage of 'current' waste equivalent to LLW and short-lived ILW pending development of a near-surface disposal site.
- Storage of nuclear fuel waste at the reactor sites, pending development of an approved long-term management method.

11. About 200 million tonnes of uranium mine and mill tailings are located at 22 tailing sites in the provinces of Saskatchewan and Ontario. Nineteen sites are no longer receiving material. Uranium tailings are decommissioned on site. Successful decommissioning has been achieved at sites in both provinces. Other sites are either being decommissioned or are still in operation. Financial responsibility for decommissioning and long-term maintenance of tailings rests with the producers.

12. Canada's major nuclear power utility is planning to initiate a site selection process in 2002 to find a suitable location for disposing of its reactor waste (mainly LLW and ILW), excluding spent nuclear fuel. The plan calls for the development of a waste disposal facility to start operations in 2015.

13. The bulk of Canada's 'historic' wastes are located in three adjacent municipalities in Southern Ontario. A Co-operative Siting Process aimed at finding a volunteer community willing to host these wastes ended in 1995 after nine years of extensive study and consultation with communities throughout Ontario. The federal government was unable to strike an agreement with the one community who came forward to accept the wastes.

14. In 1997, the three municipalities where the wastes are now located proposed that the wastes be managed in those municipalities for the long-term in newly constructed above ground engineered mounds. The federal government has accepted this proposal. Negotiations with these communities on the terms by which the proposal will be implemented should soon be completed. Detailed engineering, environmental assessment, and regulatory review will then begin and last over the next five years.

15. A proposed disposal concept for nuclear fuel waste was developed between 1981-94, involving a deep geological repository in the Canadian Shield. The concept was examined in public hearings in 1996/7 led by a Government appointed independent environmental assessment panel. Public participation was encouraged with 'intervenor funding' from the federal authorities. The Panel issued a report in March 1998 which said that the concept appeared to be technically sound, but suggested that public support had not been demonstrated.

16. The Government of Canada responded to the Panel's report in December 1998. The Government expects waste producers and owners to form a Waste Management Organization to follow up on the Panel's recommendations. It also expects waste producers and owners to establish a segregated fund to finance nuclear fuel waste management activities. The Government is currently considering appropriate federal oversight for the next steps in the long-term management of nuclear fuel waste leading to the Government's final decision on the method of management to be adopted in Canada. This oversight would ensure that next steps are carried out in a transparent manner and allow for essential public participation in decision-making.

Finland

17. Waste classification in Finland distinguishes between L/ILW and spent nuclear fuel, which is not to be reprocessed.

18. The current waste management strategy is:

- Disposal of VLLW/LLW and short-lived ILW in existing facilities.

- Storage of spent fuel in pools at the reactor sites pending disposal in a deep repository in crystalline rocks, beginning in 2020. The Finnish disposal company announced earlier this year that they had selected a site for detailed investigation.

19. Both nuclear utilities have developed shallow repositories at the NPP sites, using vertical silos and/or horizontal caverns. These began operation in 1992 and 1998 with a combined capacity of around 16,000m^3 of mainly drummed waste. There was little local opposition to the development of the L/ILW repositories at either site.

20. A site selection process for a deep repository for an expected total of 2600 tonnes of spent fuel began in 1983, and an application to develop an investigation shaft adjacent to an existing nuclear site was submitted in May 1999. A formal Government statement of approval, known as a 'Decision in Principle' has been delayed by a legal challenge, and is now expected in early 2001.

21. In Finland, although regulations state that the local community possesses an ultimate right to veto any development within its area, it was not necessary to obtain formal approval to conduct surface-based investigations for the spent fuel repository between 1983-99. In reality, local Liaison Groups were set up to inform the public about the ongoing work at the various candidate sites. However, apart from one community which asked to be considered for examination, but which was subsequently rejected on technical grounds, there was no formal public participation in the siting process. Two of the final four sites investigated were existing nuclear sites.

22. There was a marked degree of local opposition at the two non-nuclear candidate sites, whereas the local councils at the existing nuclear sites repeatedly sought to encourage selection of their localities. Following a positive result in a local poll and negotiation with the authorities, one site was selected in 1999. An expert panel advised the regulator to accept the safety case for the Decision in Principle and the continuation of the disposal project, which it did in January 2000. In addition, a municipal council vote held around the same time was in favour of the project. The Council of State must now make its own decision, which in turn has to be ratified by the Parliament.

23. The process has been delayed because of a court appeal by a number of local objectors, although this is only expected to delay rather than stop the development. Parliamentary approval is now anticipated to take place in early 2001, after which shaft sinking and underground experimental work would begin.

France

24. Radioactive waste in France is divided into two main categories, short-lived (A-wastes) and long-lived, depending on the length of time it remains a hazard. Long-lived wastes are sub-divided into B-wastes (equivalent to long-lived ILW in the UK), and C-wastes (equivalent to HLW) and spent fuel, most of which is reprocessed.

25. The current waste management policy is:

- Storage of waste equivalent to VLLW (known as TFA wastes). In September 1999 plans were announced to develop a repository for VLLW by 2002 and an interim storage facility is also to be developed at an as-yet-unknown site. It is also intended to develop another facility for the disposal of graphite and radium wastes by 2005.

- Disposal of waste equivalent to LLW and short-lived ILW in an existing near-surface repository in eastern France. The active LLW disposal site was developed following negotiation of a community benefits package (development of local infrastructure and payment of local taxes etc). Licensing for the new TFA site, to be built in the same area, has yet to begin, but discussions are already underway with local officials and landowners.

- Storage of waste equivalent to spent fuel, HLW and long-lived ILW pending development of a deep repository. Legislation has been introduced to allow funding for research into the potential for shallow storage of B and C wastes as an alternative to immediate deep disposal. A large number of possible alternative scenarios are to be examined, with recommendations to be made by the end of 2000.

26. Following a failed site selection process for a deep repository for HLW, legislation was introduced in 1991, which required comparative research in at least two underground laboratories before a final site is selected in 2006. Development of a laboratory in clay, in eastern France, was approved in 1998 and a construction licence was issued in August 1999. Two proposed sites for a laboratory in granite were rejected on geological grounds by a Government advisory body in 1998, and a new search initiated. However, this was abandoned in June 2000 following adverse public reaction in the potential areas. There have been calls for the work at the clay site to be suspended as well, and for the Government to carry out a review of HLW management as a whole.

27. Construction of the first shaft for the laboratory, in clay, is underway. The project is being monitored by special Local Information Commissions. A local Public Interest Group has also been established, which will have about £6 million per year to allocate to various local projects around the site. This will not, it is claimed, affect assistance currently received from the EU's Regional Development Fund.

Germany

28. Wastes in Germany are classified according to their capacity to produce heat, i.e. heat and non- heat generating wastes. Approximately the former can be compared with VLLW/LLW and short lived ILW in the UK, the latter with HLW, spent fuel and long lived ILW.

29. The current waste management policy is storage of non heat and non- heat generating wastes including HLW returned from reprocessing abroad until it can be disposed of. The disposal which should be done in one single repository in a qualified deep geological layer is expected to be available about 2030.

30. A wide review of nuclear power generation and waste management took place in Germany following the election in 1998. An agreement was reached between Government and the industry in June 2000 to shut down existing reactors after an operational time of 32 years and to cease reprocessing of spent fuel by the end of June 2005 at the latest which will then also be disposed of in a deep repository.

31. An operating deep repository for non heat – generating wastes in a salt dome in the former East Germany was closed in June 1999. The decommissioning procedure is now taking place to determine the sealing method.

32. A proposed repository for VLLW and L/ILW, in a closed iron-ore mine, has been awaiting an operating licence since a public hearing in 1993 which was the longest in German history. Although not directly part of the recent policy review, it is by no means certain that this repository will ever begin operations. That depends on a court order.

33. Irrespective of the decision to cease reprocessing in the middle of 2005, HLW will still be returned from France and the UK for interim storage, prior to final disposal. Up until recently it was intended that this disposal should take place in a salt dome in northern Germany, which has been under investigation since 1979. A final Suitability Statement was originally planned by 2003, with operation scheduled for 2008. Under the new agreement, work is being suspended for a minimum of 3 years and a maximum of 10 years while alternative sites inclusive of other rock types are examined, to allow for comparison before a final selection is made.

34. An extensive programme of underground research into disposal methods has been carried out in a former potash mine, where over 140,000 m^3 of non heat-generating wastes were disposed of until 1978. The disposal of heat-generating waste was simulated by "cold" experiments. The programme has finished and there will be no further disposal for experimental purposes.

35. There has been intense public opposition in recent years to shipments of both HLW from reprocessing and spent fuel to the existing storage facilities, with similar opposition to the underground characterisation work for the repository in the salt dome. The local Land Government has obstructed the examination process of this repository by every available means. Efforts have been made by the authorities to inform local inhabitants of progress, and there has been a permanent information office at the proposed repository site since 1979.

36. A specialist commission has been established to set up safety criteria for repositories and examine future repository siting, with a sub-group concentrating on public involvement issues. Members of the public, environmental groups and local politicians are to take part in a series of workshops and discussions to inform the commission on the issues.

Japan

37. Waste classification is very similar to that in the UK.

38. Major organisational changes have taken place in nuclear waste management in Japan since a fire at a research reactor in 1995, and the recent explosion at a processing plant seems likely to result in more changes.

39. A Governmental statement on radioactive waste management is expected shortly, following passage of a new HLW law in June 2000. At the present time, waste management policy is as follows:

- Disposal of VLLW, LLW and short-lived ILW in an operational near-surface facility in northern Japan, which is being developed in stages. LLW disposal began in 1992 and it is also planned to place ILW from decommissioning in silos. The facility has a total capacity of 600,000m^3 of waste

- Storage of spent fuel at existing nuclear sites or at off-site stores yet to be developed (construction of these are allowed under the new HLW law).

- Storage of vitrified HLW and long-lived ILW from reprocessing of spent fuel in Europe, at an existing facility, prior to disposal in a deep repository at a site yet to be identified.

40. The last shipment of spent fuel to Europe took place in 1998. HLW and long-lived ILW will also be produced at a national reprocessing facility currently under construction, although this is several years behind schedule, and not expected to begin operation until at least 2005. A store for returned HLW is already in operation at the same site in northern Japan. Up to 50,000 canisters will have been produced by 2030 from over 10,000 tonnes of reprocessed spent fuel.

41. The site for the LLW repository (which is also that of the reprocessing facility and HLW store) was selected by the national authorities. Because of low public confidence in the industry at the present time, the 'Nuclear Fuel Cycle Council' has been established, which involves national and local Government officials, including the Governor of the Prefecture in which the facility is situated. Amongst other things, this is intended to increase public involvement in safety monitoring at the site.

42. The new HLW law mandates the creation of a new organisation, with overall responsibility for HLW disposal, in October 2000. This organisation must produce a future strategy for repository siting and development, which is likely to result in the examination of a number of sites, beginning around 2004. Several underground studies in existing mines have already been carried out, and two more underground research facilities are planned.

43. The new liaison committee established at the LLW disposal site will also inform local people and officials about the development of the reprocessing plant there, as well as involving them in the monitoring of the vitrified HLW store. Although other national fora, which tend to involve officials rather than members of the public, have continued to discuss long-term waste management strategies, the 'Long term Nuclear Energy Policy Forum' was established in March 1996, and is intended to allow open and frank discussion by sceptics and nuclear opponents.

44. Agreements have been reached to pay similar compensation packages to communities around existing waste facilities as are currently paid to those around reactor sites, and it is possible that the same will be offered to candidate sites for a deep repository, to encourage them to volunteer to be examined.

Netherlands

45. Waste classification in the Netherlands is similar to that in the UK, although volumes are considerably less as there is only one operating power reactor.

46. Current waste management policy is:

- Storage of LLW and ILW at a single central facility adjacent to an existing nuclear site, prior to disposal in a single repository. It has yet to be decided how long the period of storage will be, with current estimates ranging from 50-300 years on the surface, followed by about 300 years underground before final closure. The storage facility has already been operational for nearly 10 years.

- Overseas reprocessing of spent fuel followed by storage of the returned HLW, prior to disposal in the same repository as for other wastes. Licences for the construction of these storage facilities have only recently been granted.

47. As regards research into repository siting and development, a detailed programme examining the feasibility of construction in either salt or clay was completed on schedule at the end of 2000, as was an assessment of various long-term management strategies, including extended surface storage. Retrievability is a pre-requisite of all conceptual designs.

48. There was considerable local public disquiet when the site of the storage facility was originally selected in 1988. Widespread public consultation and subsequent local review led to the facility being built on a slightly different site from the one originally selected.

49. There is a continuing national debate as to whether wastes should be placed into a deep repository at all, or should remain on the surface in monitored retrievable stores.

Russia

50. Radioactive wastes in Russia are classified along the same lines as those in the UK. Huge volumes exist at numerous civilian and military sites, usually stored in untreated and often liquid form. For example, there are over 30,000m^3 of liquid HLW and over 25,000 tonnes of spent fuel currently in storage, with as much as 700,000m^3 of solid and 500,000m^3 of liquid LLW expected by 2010.

51. The present waste management policy is:

- Development of new conditioning and storage facilities at numerous sites, in particular for liquid wastes, at both reactor sites and at the bases for the Northern and Pacific Fleets.

- Development of treatment facilities for L/ILW from reactors and disposal in near-surface repositories which are yet to be sited.

- Disposal of VLLW and L/ILW from industrial sources in existing trenches and boreholes, with development of engineered replacements at new sites.

- Storage of spent fuel at reactor sites in facilities yet to be developed, followed by disposal in deep repositories yet to be sited.

- Vitrification of the large volumes of liquid HLW from military and civilian reprocessing facilities, followed by disposal in deep repositories. Large volumes of liquid waste have also been injected into the ground in the past.

52. It has been proposed to develop a repository for military LLW in permafrost in northern Russia and a deep repository for industrial wastes near to Moscow, in salt or clay. There are currently no sites being sought for disposal of reactor L/ILW.

53. Construction of a new reprocessing facility was halted in 1998. There is now a proposal involving a US-based company to develop an international spent fuel storage facility on the same site, although this would require a change in Russian law, to allow for the material to be imported. There are also separate programmes underway to identify suitable sites for deep repositories for the HLW from the former military and civilian reprocessing sites in central Russia and Siberia, as well as spent fuel and other wastes from various naval and military bases. The international community has offered financial support for these efforts. The UK has pledged £80m to support efforts in the management and disposal of military wastes.

54. There is a steadily increasing public involvement in various nuclear matters, including organisation of local referenda, and local environmental groups have also begun to use the courts to try and prevent such practices as deep injection of HLW and new reactor construction. In some cases the public is only just becoming aware of the existence of particular facilities.

Spain

55. Although classification has not been determined by Spanish regulations, radioactive waste in Spain is classified in a similar way to that in the UK with VLLW, LLW and short-lived ILW distinguished from HLW, spent fuel and long-lived ILW. Up to 200,000m^3 of these wastes, plus 6750 tonnes of spent fuel and 80m^3 of HLW, will require management by 2020.

56. The present policy is:

- Disposal and landscaping of mounds of U-mine tailings

- Disposal of VLLW and L&ILW in an existing near-surface repository in southern Spain.

- Interim storage of spent fuel for short term on site nuclear power plant, using both dry and wet methods

- Storage of spent fuel from 2010 in a central facility prior to disposal in a deep repository, both at sites yet to be selected. The choice of a disposal site has been suspended until 2010.

- Reprocessing of a limited amount of spent fuel abroad, followed by storage of the returned HLW prior to disposal in the deep spent fuel repository. The option to reprocess larger amounts of spent fuel is currently still available.

57. The near-surface repository of El Cabril, began operation in 1992. El Cabril has been designed as a near surface disposal facility fully engineered for L&ILW in a very sparsely populated area, on the site of a former uranium mine.

58. A step-wise programme of research into deep disposal of HLW/spent fuel began in 1986, together with a programme designed to identify potentially suitable sites for a repository. The siting programme was stopped in 1998 and, following Government adoption of a new 'General Radioactive Waste Plan' in July 1999. No further work on site selection will take place until 2010. There will continue to be extensive involvement in underground research facilities in a number of other countries, and additional research on transmutation and partitioning of wastes will also be carried out.

59. The L&ILW near surface disposal facility of El Cabril was sited without any formal public involvement, although a visitor and exhibition centre has been developed on the site.

60. Throughout the deep repository research programme, there has been intense public opposition to any site investigations, including throughout the operation of a research facility at a former uranium mine site in granite. Because of this opposition, it is planned to introduce volunteerism into any site selection process in the future.

Sweden

61. Radioactive waste in Sweden is classified in a similar way to that in the UK. Spent fuel is not reprocessed.

62. The present policy is:

- Disposal of VLLW in shallow trenches at existing nuclear sites.

- Disposal of LLW and short-lived ILW in an existing shallow repository in the rock 50m below the bed of the Baltic Sea, adjacent to an existing nuclear reactor site north of Stockholm. Wastes from reactor decommissioning are planned to go into another repository co-located with this facility.

- Storage of spent fuel in a central facility at an existing nuclear site in southern Sweden, prior to disposal in a deep repository in crystalline rocks at a site yet to be selected. Spent fuel is transported to the storage site by ship.

63. The near-surface repository began operation in 1988, incorporating a number of horizontal rock caverns for LLW and a vertical concrete silo for ILW. The L/ILW repository was sited despite some public opposition. It has now operated for over 10 years and the public concern has largely faded away. It has yet to be finally decided how and when the facility will be closed and sealed.

64. Research into the deep disposal of spent fuel began in 1977. The present design concept was accepted as a basis for further planning and research and development work in 1984, and it has eventually also become accepted as a form of global standard. Sweden operated the world's first underground research laboratory in a disused iron-ore mine. A second laboratory, close to the spent fuel storage facility, began operation in 1995, with co-operative projects involving numerous other countries, including the UK.

65. In order to develop a deep repository for spent fuel, boreholes were drilled at a number of sites in the 1980s. Since 1992 a number of so-called 'Feasibility Studies' have been carried out in northern Sweden and, more recently, at or near existing nuclear sites. Two sites are due to be recommended for further investigation. It is then planned to drill boreholes at these sites from 2002, after which a final site will be selected for repository construction.

66. All the drilling work carried out as part of the spent fuel repository project in the 1980's was accompanied by local opposition. From 1992 communities throughout Sweden were invited to volunteer for 'Feasibility Studies' in which no drilling would be carried out. Because of a fairly poor initial response, in 1995 existing nuclear sites were specifically encouraged to volunteer.

67. Originally, only two communities, both in northern Sweden, volunteered to join the process, and both have since voted by public referendum to reject further investigations. At the present time, another six 'Feasibility Studies' are underway, or completed, all at communities either containing or located near existing nuclear sites, and all underlain by crystalline rocks. Two sites will be identified by the waste producers' organisation for more detailed investigation. Local referenda may be held in these communities on whether to continue with repository development.

Switzerland

68. Radioactive waste in Switzerland is classified in a similar way to that in the UK. Over 100,000m^3 of VLLW, LLW and short-lived ILW will be produced in total by the Swiss nuclear programme, together with around 3000 tonnes of spent fuel, most of which is likely to be reprocessed. This will result in approximately 500m^3 of vitrified HLW.

69. The present policy is:

- Storage of VLLW, LLW and short-lived ILW in central waste storage facilities, followed by disposal in a site which has been selected, but not yet approved.
- Storage of spent fuel at the reactor sites, followed by shipment overseas to France and the UK for reprocessing.
- Storage of vitrified HLW returned from France and the UK, together with long-lived ILW, in the central storage facility, followed by disposal in a deep repository at a site yet to be selected.

70. Switzerland is also open to the idea of disposal in an international repository, if one were ever built.

71. Siting studies for a deep repository for L/ILW began in 1978, and as many as 20 sites were examined. In 1993 a single site in central Switzerland was selected for the development of a repository, after the drilling of a number of boreholes into a marl formation. It is proposed to tunnel into the side of a 500m high mountain, in order to continue with the investigation of the site, but no underground work has yet taken place because of local opposition.

72. A disposal concept for HLW was accepted by the Swiss Government in 1988. Related siting studies had begun in 1980, and are still in progress. Two parallel investigations are underway to identify potential areas in both clay and crystalline rocks, involving boreholes and other investigation methods. A final decision on which rock type is to be used is to be taken around 2005, after which a suitable site will be sought.

73. An underground laboratory in crystalline rocks, beneath a mountain in central Switzerland, has been in operation since 1983, and a second, in clay, has recently been developed adjacent to a road tunnel in the north-west of the country. Workers from many other countries are involved in jointly-funded research in these facilities.

74. In order to carry out any underground work for the proposed L/ILW repository, a local licence is required. In Switzerland this is subject to local approval in a referendum, and in 1995 permission to proceed was refused. Efforts to gain public acceptance have continued up to the present, with a second referendum planned. This would address an amended disposal concept in which waste could be recovered or retrieved if this were considered necessary, together with construction of a pilot-scale facility where extensive testing would take place, as suggested recently by an expert panel. It is now also only proposed to carry out limited initial underground investigative work at the site, after which further local approval would be sought.

75. Although no specific sites have been identified yet for the development of a deep HLW repository, there has been some local opposition to the investigations carried out in the research programme so far. After the public acceptance problems associated with the L/ILW plans, it is possible that some form of voluntary process may be adopted in the future when specific sites are sought.

United States

76. Radioactive waste in the United States is classified slightly differently from that in the UK.

77. For example, all waste containing plutonium and other similar long-lived radionuclides, is referred to as Transuranic or 'TRU-waste', equivalent to long-lived ILW in the UK. Over 100,000m^3 of these wastes are stored in drums at many defence-related sites around the country, together with larger volumes of loose waste in landfills etc. The large commercial nuclear power programme is expected to produce at least 87,000 tonnes of spent fuel, in addition to the 2600 tonnes of defence-related material from submarines etc. No reprocessing of commercial spent fuel has taken place since 1977, although HLW has been produced by the defence programme.

78. All other wastes excluding uranium and thorium mill tailings are classed as LLW, and are segregated depending on the length of time over which they remain hazardous. Some wastes which are disposed of in shallow facilities in the UK would have to go to a deep repository in the United States.

79. The current policy for waste management is:

- Disposal of LLW (equivalent to VLLW, LLW and short-lived ILW). Defence wastes are disposed of at a number of private sites. Commercial LLW is the responsibility of a State or groups of States, some of which have access to existing surface repositories, whilst others do not.

- Disposal of TRU-waste (ILW) in a deep repository in salt in southern New Mexico. The capacity of this is insufficient for all the waste which currently exists.

- Storage of defence and commercial spent fuel, possibly in a central facility, prior to disposal in a deep repository at a desert site currently under investigation. Operation is planned for 2010.

80. A number of commercial LLW repositories which predate existing regulations have been closed in the US over the last 10 years, some of which have been shown to have been poorly designed. Only three near-surface facilities are currently operational, in the south-east, mid-west and in the far north-west. Not all wastes from the various 'Compacts' are disposed of in these, and many of the 'Compacts' have tried to develop their own disposal facilities. To date, no new LLW repositories have actually been sited.

81. A repository for TRU-waste of defence origin was constructed at a depth of 650m in a salt deposit in New Mexico in 1981, but only began operation in 1999.

82. A siting programme for a deep repository for commercial spent fuel and defence HLW began in 1977, but the original intention of identifying several potential sites across the country, to allow for comparison, was abandoned in 1987 when the programme was focussed on one site in the Nevada desert, close to the nuclear weapons test site. Site characterisation has continued there ever since, including the development of a tunnel into a mountain, in which some experimentation is currently taking place. It is planned to issue a site suitability report and then make a formal recommendation to the President.

83. The efforts in many of the LLW 'Compacts' to site new repositories have generated continuous opposition. Siting methods have involved use of many types of volunteerism, including payment of large amounts of money to communities for even allowing preliminary investigations to take place. All efforts to date have failed. In some cases, different sections of the Federal and State Governments have been on opposing sides.

84. Attempts to identify a site for a central spent fuel storage facility failed after an 8 year programme. This had involved the payment of large sums to interested communities, many of which were small Native American groups, whose participation in the process was actively opposed by the relevant State Governments. Numerous efforts have taken place over recent years to pass legislation to mandate storage of spent fuel in Nevada, pending the development of the repository. However these proposals have all been vetoed by the President. It is also possible for private initiatives to be advanced for the development of spent fuel stores. Two independent proposals for a commercial storage facility are currently subject to regulatory review.

85. The selection of a single site for a deep HLW/spent fuel repository, in legislation passed in 1987, has produced intense opposition in the host State. Federal funds were provided for local monitoring of the technical results of the site investigation until 1995, when they were restricted to local community activities only.

APPENDIX 5

Principles

Summary

1. This appendix sets out the principles of sustainable development and describes how they might be applied to the development of policy for the management of radioactive waste.

Sustainable Development

2. At the heart of the concept of sustainable development lies the simple idea of ensuring "a better quality of life for everyone now, and for generations to come".[26] It seeks simultaneously to deliver social progress that recognises the needs of everyone, effective protection of the environment, prudent use of natural resources, and the maintenance of high and stable levels of economic growth and employment. A widely used international definition has been "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[27]

3. In its strategy document "A Better Quality of Life" (May 1999), the Government set out a number of principles to underpin the concept of sustainable development[28]. The Government believes that the development of policy for the management of radioactive waste should also be based on the principle of sustainable development.

PUTTING PEOPLE AT THE CENTRE

4. The first and foremost concern of the Government and the Devolved Administrations is that radioactive wastes should be managed in ways that protect both the safety of the public and the workforce, and the environment now and in the future. The development of policy should therefore follow the UK's well-established principles for providing radiological protection:

- The "Justification" principle – no practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society as a whole to offset the radiation detriment it causes.

- The "Optimisation" principle – in relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account.

26 This is the UK Definition as set out in "A Better Quality of Life" DETR (May 1999).

27 From "Our Common Future" (The Brundtland Report) – Report of the 1987 World Commission on Environment and Development.

28 In Wales, the National Assembly last year adopted a scheme designed to incorporate sustainable development into all aspects of its work, including policy development.

- Individual dose and risk limits – the exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. These are aimed at ensuring that no individual is exposed to radiation risks that are judged to be unacceptable from these practices in any normal circumstances.

RESPECTING ENVIRONMENTAL LIMITS

5. Some radioactive wastes are potentially harmful for hundreds of thousands of years and if released in sufficient quantity may cause serious or irreversible harm to the environment. These wastes will have to be managed in the ways most likely to limit the harm to the environment over this long timescale.

6. The well-being of humans clearly depends upon the well-being of the environment, including the organisms which inhabit it. In the past, most attention has been given to the protection of humans. The current International Commission on Radiological Protection (ICRP) system of radiological protection is based on a belief that the standard of radiological control needed to protect humans to the degree thought desirable will ensure that other species are not put at risk. We recognise that this is a rapidly changing field. Provisions specifically related to the protection of the environment from harmful effects of radiation are now being included within national legislation in several countries, and within international conventions, and the ICRP is in the process of reviewing its recommendations. Research work is planned within the European Union's 5th Framework Programme, in which the Environment Agency is playing a leading part, to create a framework for assessing the impact of radioactive contamination on the environment. We shall continue to follow these developments closely, and to encourage the involvement of UK organisations in them.

TRANSPARENCY, INFORMATION, PARTICIPATION AND ACCESS TO JUSTICE

7. In their report on "The Management of Nuclear Waste", the House of Lords Select Committee on Science and Technology concluded that the views of the public had been neglected in previous attempts to develop policies for the long-term management of radioactive waste in the UK. Instead there was an over reliance on the nuclear industry to establish or change public views, to formulate its preferred policy and to gain public acceptance of it (the 'decide, announce, defend' approach).

8. With hindsight, this failure to engage with the public can be seen to have contributed to the view that Nirex were excessively secretive about their work. This helped foster objectors' concerns that scientific evidence was not being published when it failed to support the disposal concept, and that the process of site selection was 'unfair' because it was designed to reach a particular answer rather than choose the 'best' location.

9. The mistakes of the past must not be repeated. In future, the development and implementation of policy for the management of radioactive wastes must be characterised by openness, transparency, inclusiveness and integrity. Proposals for achieving this are in Chapter 5.

THE PRECAUTIONARY PRINCIPLE

10. The precautionary principle states that uncertainty should not be an excuse for inaction. Where the potential for harm exists, an assessment should be taken of the costs and benefits of the different environmental options, and a decision made on how best to proceed. As some radioactive wastes are potentially harmful for hundreds of thousands of years, there will inevitably be an element of uncertainty over their long-term management. We shall seek to generate scientific research to reduce that uncertainty as far as possible, but we recognise that there are some questions for which the answers may never be known.

USING SCIENTIFIC KNOWLEDGE

11. Decisions on how potentially harmful wastes should be managed need to be based on the best possible scientific information and analysis of risks. Furthermore these decisions need to be seen to be based on the best possible scientific advice. Research must be conducted in as open and transparent a manner as possible, and subject to rigorous peer review. Proposals for how this scientific information could be generated are in Chapter 6.

MAKING THE POLLUTER PAY

12. We firmly endorse the polluter pays principle and believe that the producers and owners of radioactive waste should remain responsible for bearing the costs of managing the waste – including the costs of regulation and related research. These costs have been rising steeply in recent years. Most of the radioactive wastes currently requiring management, or expected to be produced in the future, result from work done by, or on behalf of, Government for the development of nuclear technology. The majority of any costs for managing these wastes will therefore fall to the taxpayer.

TAKING A LONG TERM PERSPECTIVE

13. We believe that the present generation, which has received the benefits of nuclear power and nuclear medicine over the last 50 years, should address the problem of radioactive waste rather than passing it on to future generations.

14. However, as wastes can continue to be stored safely in the medium term using current technology[29], the timetable for the consideration and implementation of policy should be driven by the need to develop a clearer understanding of the safety and environmental issues associated with each potential option for the long term management of radioactive waste.

29 HM Nuclear Installations Inspectorate "Intermediate Level Radioactive Waste Storage in the UK: A Review" (November 1998)

15. Following the current consultation on the processes involved in choosing a policy for the management of radioactive waste, the next step would be for a further consultation to choose that policy. It is envisaged that this second consultation would involve an in-depth examination of the pros and cons of the potential management options, including costs, and result in the Government and the Devolved Administrations adopting a preferred policy for managing radioactive wastes. An indication of our timetable for action is set out in Chapter 7.

TAKING ACCOUNT OF COSTS AND BENEFITS

16. The radiation protection principles and criteria adopted in the UK and applied by the regulatory bodies are designed to ensure that there is no unacceptable risk associated with radioactive waste management. In defining these principles and criteria and in their application by the regulators, it is recognised that a point is reached where additional costs of further reductions in risk exceed the benefits arising from the improvements in safety achieved and that the level of safety, and the resources required to achieve it, should be consistent with those accepted in other spheres of human activity. It is acknowledged that public concern about risks may differ in different spheres of human activity. Information about the level of public concern about particular risks could also be an important factor in making choices between radioactive waste management options.

CREATING AN OPEN AND SUPPORTIVE ECONOMIC SYSTEM

17. Countries which are sophisticated enough to have a nuclear industry should also be able to develop their own waste facilities. However, countries should not be precluded from taking advantage of the non-nuclear uses of radioactivity, such as medical diagnosis and treatment, because they do not have the resources to develop waste facilities.

18. Radioactive waste should therefore not be imported to or exported from the UK, except for:

- the recovery of reusable materials (provided that this is the genuine prime purpose) or
- for treatment that will make its subsequent storage and disposal more manageable, in cases
  - where the processes are at a developmental stage, or
  - which involve quantities which are too small for the processes to be practicable in the country of origin.

19. Where such processes would add materially to the wastes needing to be disposed of in the UK, the presumption should be that they will be returned to the country of origin.

20. In addition, waste may be imported for treatment and disposal in the UK for non-proliferation purposes; or if it is in the form of spent sources which were manufactured in the UK; or if it is waste from small users, such as some hospitals, situated in EU member states which produce such small quantities of waste that the provision of their own specialised installations would be impractical, or developing countries which cannot reasonably be expected to acquire suitable disposal facilities.

APPENDIX 6

How Devolution affects radioactive waste management in the UK

SCOTLAND

1. The Scottish Executive assumed its full powers and duties on 1 July 1999. On that date, the powers and duties and other functions exercised by UK Ministers in Scotland relating to devolved matters transferred to the Scottish Ministers. UK Ministers ceased to exercise those functions in Scotland. These included functions of observing and implementing obligations under European Community law which relate to matters within devolved competence. Acts of the Scottish Parliament will be able to confer new functions (within devolved competence) on the Scottish Ministers or amend those which they inherited.

2. Among the areas on which the Scottish Parliament can make primary legislation are environmental issues and, while nuclear energy and nuclear installations, particularly nuclear safety, security, safeguards and liability for nuclear occurrences are reserved matters, the subject matter of the Radioactive Substances Act is excepted from that. It is thus the responsibility of the Scottish Executive to develop policy for radioactive waste management in Scotland.

WALES

3. In Wales, most of the functions previously exercised by the Secretary of State under the Radioactive Substances Act 1993 transferred to the National Assembly on 1 July 1999. It will, therefore, be for the Assembly to develop policy on managing radioactive waste and to issue appropriate guidance to the Environment Agency in respect of its activities in Wales. Responsibility for nuclear energy and nuclear installations, including nuclear safety, security, safeguards and liability for nuclear occurrences, have not been devolved to the National Assembly.

NORTHERN IRELAND

4 The Northern Ireland Executive assumed its full powers on 2 December 1999. On that date the powers and duties and other functions exercised by UK Ministers in Northern Ireland relating to devolved matters transferred to Northern Irish Ministers. Devolved matters include observing and implementing obligations under European Union Law.

5. Areas where the Northern Ireland Executive can make primary legislation include environmental issues. However, nuclear energy and nuclear installations, including: safety, security and liability for nuclear occurrences remain reserved matters. There are currently no nuclear licensed sites in Northern Ireland, but radioactive waste is produced in small amounts from hospitals and industry.

The Relationship Between the Devolved Administrations and the UK Government

6. The Devolved Administrations and the UK Government have undertaken to keep each other informed of developments in policy and practice in their respective areas, including proposals for legislation and other initiatives. The effects of proposals on the other areas and interactions between them will be considered.

APPENDIX 2

Sellafield shuts plants as N-waste builds up

Special report: Britain's nuclear industry

Paul Brown, environment correspondent
Guardian

Saturday September 22, 2001

Both giant nuclear fuel reprocessing plants at Sellafield in Cumbria, which employ more than 4,000 people, were shut down yesterday after it became clear that volumes of high level nuclear waste were reaching unacceptable levels.

Government regulators, the Nuclear Installations Inspectorate, have been critical of state-owned British Nuclear Fuels for its failure to deal with heat producing waste, the most dangerous material stored at the plant.

Earlier this week, Sellafield was identified as a potential terrorist target following the attack on New York.

Despite many attempts to reduce the amount of liquid waste, the plant which turns the waste into more manageable glass blocks, has broken down repeatedly. It has been out of operation most of this year. None of the three production lines in this vitrification plant are currently working and the amount of waste is rising, instead of falling as the regulators have demanded.

The two reprocessing works deal with spent fuel from Britain's nuclear reactors and from customers in Japan, Germany, Switzerland, Sweden, Spain and Italy. Staff will not be laid off, but halting production will seriously damage the profitability of the company.

Foreign customers are already angry at Sellafield's failure to deal with their contracts in time. This has caused a 10% increase in costs, running into many millions of pounds, which is passed on to BNFL customers.

The company was warned again in August that unless it reduced the amount of waste in holding tanks - currently more than 1,550 cubic metres- by 35 cubic metres for the next 14 years the NII would close the plant. This year the amount of waste held has already increased by more than 100 cubic metres.

Yesterday, the company said it had closed both reprocessing plants for maintenance. Reopening of the two plants, which are the main money spinner for BNFL, depends on getting the vitrification plant running properly, something it has not achieved since it opened 11 years ago.

It has only achieved 34% of potential production in a decade, leading to such a build-up of dangerous wastes that the Irish government has protested to Britain about the threat to its citizens posed by the highly volatile liquid.

Yesterday, a spokesman for BNFL said the company hoped to have two of the three vitrification lines open next month and the third is due to be commissioned by the end of the year.

Martin Forwood, from Cumbrians Opposed to Radioactive Environment, said: "It is clear BNFL have jumped before they were pushed and shut the plants down rather than face legal sanction. The company is already years behind on its production schedules and has some very angry customers. This will make matters worse."

APPENDIX 3

CORE

Press Release

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Embargo: NIL
Date: 21/9/01

BNFL forced to close Sellafield reprocessing plants.

Contradicting an official company statement in this week's Sellafield Newsletter, sources inside Sellafield have confirmed to CORE that the THORP reprocessing plant has been closed down because levels of liquid High Level Wastes (HLW) have reached the upper limit imposed by the Nuclear Installations Inspectorate (NII) – and not ' for routine maintenance '. It is understood that Magnox reprocessing in B205 has also been closed down

The current build up of dangerous wastes has resulted from BNFL's inability to successfully operate the Waste Vitrification Plant (WVP) in which HLW is converted to a solid glass form. WVP's historic poor performance has been heavily criticised by company customers, and NII has repeatedly warned that unless the plant operated satisfactorily, they would order the closure of THORP to prevent further stocks of HLW arising from reprocessing.

A CORE spokesperson said today " **We have already warned customers that this would happen. BNFL can dress it up however they want, but the reality is that in closing THORP themselves, BNFL has simply jumped before being pushed by the NII. It will be several months before the plant can operate again – and only then if the Vitrification plant is up and running. Overseas customers will be furious at this further delay which represents another nail in THORP's coffin.**

BNFL advised overseas customers that their contracts would be completed by March 2005, requiring THORP to reprocess at least 950 tonnes per year. This target will clearly not be met this year by THORP – the fourth year in succession that targets have been missed. None of WVP's three production lines are currently working and are not expected back into production until next month at the earliest.

Notes:

i) In January this year NII issued BNFL with a Specification which required the current HLW stocks (1575m3), held in srorage tanks, to be reduced by annual increments to a buffer stock of around 200m3 by 2015. Stock reduction can only be achieved by vitrification. Effectively, NII's Specification means that in any year, BNFL can produce no more liquid HLW via reprocessing than they can remove from the storage tanks by vitrification.

ii) In June, CORE published its report 'BNFL & Reprocessing – The Deception of Customers Continues' which scrutinised the Company's reprocessing and vitrification plans. It concluded that WVP's insufficient production capacity and poor performance would lead to periodic stoppages to THORP and possibly Magnox reprocessing,, resulting in many years delay in completing customers contracts.

iii) As at end August 2001, 366 tonnes had been reprocessed in THORP and 296 tonnes of Magnox fuel in B205 in the financial year. During that period, WVP had produced around 40 cannisters (cans) of vitrified HLW only, significantly fewer than the number required to making the necessary inroads into reducing liquid HLW stocks.

APPENDIX 4

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Airliner Crash on Nuclear Facilities
The Sellafield Case

Xavier COEYTAUX*, Yacine B. FAÏD*, Yves MARIGNAC**, Mycle SCHNEIDER***, WISE-Paris

Paris, 29 October 2001

1. Sellafield Particularly Exposed to Plane Crash Risk

Among the nuclear facilities located on the British territory, the scenario of a targeted plane crash on BNFL's Sellafield facilities would be the most extreme in terms of impact on the environment and public health: the spent fuel reprocessing facilities in Cumbria represent an inventory of radioactive substances several orders of magnitude larger than that of a nuclear power station. The site is used to store hundreds of cubic meters of liquid high level waste, thousands of tons of irradiated fuel, tens of tons of separated plutonium.

Sellafield vulnerability regarding an aircraft crash stems in particular from the 1,550 m^3 of liquid high level waste in storage, which represent a non conditioned and therefore very volatile inventory of liquid fission products. In addition, over 75 t of separated plutonium in powder form were in storage on the site as of 31 December 2000[1].

With its French equivalent in La Hague, the Sellafield site concentrates the largest inventory of radioactivity in Europe. With nominal reprocessing capacities of 1,580 t per year of Magnox fuel for the B205 plant and around 1,200 t of oxide fuels for the B570 THORP[2] plant, Sellafield differs however from the La Hague site[3] by the way reprocessing have been operated during the last decade.

Frequent operational problems have led to low load factors of the reprocessing lines during the last 11 years, as well as the waste conditioning facilities. During these years, waste has been accumulating year after year of which hundreds of cubic meters of liquid high level waste.

The unavailability of the vitrification facility, which has achieved a production of only 34% of its nominal capacity over the last decade, made the temporary stock of liquid fission products grow to more than 1,550 m^3 as of September 2001. That situation has been considered unacceptable by the Nuclear Installations Inspectorate in late September 2001. The subsequent closure of the two reprocessing plants on 22 September 2001 can be interpreted as BNFL's response to the NII warning. Opening of two of the three vitrification lines in October 2001 (according to BNFL) will not rule out the particular risks that will continue to remain for years.

In January 2001, the NII issued BNFL with a Specification (a legal order), which limits the volume of liquid high level waste to 1,575 m^3, lowers this limit by 35 m^3 per year until 2012, and requires a subsequent reduction to 200 m^3 in 2015; thereafter, BNFL would be permitted to store 200 m^3 of liquid high level waste as a buffer stock. This Specification is designed to accommodate BNFL's business plan, and to minimise the cost and inconvenience to BNFL of reducing the stock of liquid high level waste.

*Research Associate, **Deputy Director, ***Executive Director

1 DTI, PQ N° 2001/474, 17 July 2001.
2 Thermal Oxide Reprocessing Plant.
3 See WISE-Paris briefing, *"La Hague Particularly exposed to Plane Crash Risk"*, 26 September 2001.

2. The potential impact of a typical accident

Although there are three main areas of concern regarding the risk of an accidental or voluntary plane crash on reprocessing facilities – i.e. respectively the spent fuel, separated plutonium and highly active waste stocks –, the specific, and probably major risk in Sellafield (see the site map in ***Annex I***) is due to the liquid form of large amounts of highly active waste in storage.

WISE-Paris has carried out some calculations on the hypothesis of an aircraft crash on the high level waste tanks building with loss of safety equipment i.e. cooling systems. In this scenario, the temperature inside one or more tanks could increase significantly, up to the boiling and evaporation temperature of the solution. Once evaporated, the solid residue obtained would release volatile radioactive materials contained and especially the caesium-137. Uncertainty remains on the fraction of materials released in such a scenario, but a significant share of the inventory could be assumed as *"BNFL accept that if there were to be complete failure of cooling in all the HASTs (Highly Active Storage Tanks), the system including electrostatic precipitators, and scrubbers, could be overwhelmed".*[4]

In order to simplify the approach, we limit our consideration in the present paper to the question of caesium-137. The choice is justified by the experience of the Chernobyl accident. Many radionuclides in various quantities were released in the course of this accident, but the release and dispersion of caesium-137 accounts for about three quarters of the long term and collective offsite exposure following the reactor accident.

The B215 building, which is housing all of the 21 tanks of liquid high level waste is partitioned in cells separating the different storage tanks. However, the 1-8 tanks of 70 m^3 capacity are grouped by two for one cell and each of the 9-21 tanks of 160 m^3 capacity are placed in single separate cells.

The average composition of the high level liquid waste stored at Sellafield arrives at a total of around 1.63 kg of caesium-137 per cubic meter of fission products solution (5.26 TBq or 1.63 g per liter). It can therefore be assumed that the total inventory of caesium-137 in the 21 tanks is currently around 2.53 t of which 173 kg in the 1-8 tanks and 2,353 kg in the 9-21 storage tank[5]. Calculations have shown that in a "loss of cooling" scenario, the boiling temperature could be reached within 10-14 hours and that significant evaporation could start after 12.5 hours. However these calculations do not take into account the high thermal input of the jet fuel fire following a plane crash which could probably significantly shorten these figures.

Moreover, the B215 building and the cells in which the storage tanks are housed have not been designed to resist a commercial or military plane crash. In such an event, the two scenarios of release, either loss of cooling leading to boiling, or immediate aerial release due to tank rupture following the direct crash on one cell, would lead to significant doses. In 1994, the COSYMA computer model was used to assess the consequences of an atmospheric release from the Sellafield high level waste tanks, to range up to tens of millions of person-Sievert.[6] According to the internationally used risk factor of 5% fatal cancer risk per person-Sievert[7], this release could lead over the long term to hundreds of thousands of deaths.

However, the scenarios of caesium-137 releases should not be limited to the rupture of a single storage tank alone, but should also take into account the possible "domino" effect that could lead to the release of the radioactivity contained in several storage tanks. The UK Nuclear Installations Inspectorate (NII) has described the safety level in B215 "*where active systems, requiring operator control, are needed to keep the HAL [liquid high level waste] in a safe state.*" In fact, the cooling circuits of the different

---

4 FJ Turvey and C Hone, RPII, *"Storage of Liquid High-Level Radioactive Waste at Sellafield"*, December 2000.

5 Idem.

6 Taylor P. (1994), *Consequence Analysis of a Catastrophic Failure of Highly Active Liquid Waste Tanks Serving the THORP and Magnox Nuclear Fuel Reprocessing Plants at Sellafield,* Nuclear Policy and Information Unit, Manchester Town Hall, Manchester, February 1994.

ICRP *1990 Recommendations of the International Commission on Radiological Protection,* ICRP, Publication 60, Pergamon Press storage tanks are not absolutely independent, and a single storage tank accident would likely lead to the disability of other cooling circuits (because of fire and/or explosion) which itself would finally engender boiling and release from some other storage tanks. We can therefore assume that because of the possible "domino" effect in loss of cooling systems, a scenario of the release of all the caesium-137 contained in the 21 storage tanks cannot be ruled out.

Moreover, considering the dimensions of a commercial airplane such as a Boeing-767, it seems highly optimistic to look at the consequences of a single storage tank release. A direct hit on the B215 would certainly concern more than one storage tank. The projection of the potential zone of damage in the event of a large plane crash shows that large parts or even the entire building could be affected (see *Annex 2*).

On the hypothesis of a release of 50% of the B215 caesium-137 inventory, such an accident would lead to up to 48 times the quantities of caesium-137 released during the Chernobyl accident (or 26,4 kg).

Conclusion

Although the release mechanism would be very different from that of a core melt accident and the forecasting of the precise release fraction is impossible, a severe accident or terrorist attack on the high level waste tanks in building B215 could lead, considering the same conditions of dispersion[8], to an impact **several dozen times the global and long term impact of the Chernobyl accident**.

With the radioactive caesium-137 inventory of the high level waste tanks reaching about 100 times the quantity released at Chernobyl, even a limited release of 1% of the total ceasium-137 inventory, the dimension of the impact under such a scenario would be still comparable to the Chernobyl accident.

3. UK legal framework and BNFL's aircraft risk assessment

• ***Risk analysis***

Under the Nuclear Installations Act (1965), the safety of a nuclear plant is the responsibility of the operator, or licencee. The latter is required to submit to the Nuclear Installations Inspectorate (NII) *"a written demonstration of safety, the safety case, which is periodically updated to reflect changing conditions"*. The Safety Case is then assessed by the NII to determine whether it is *"adequate"*, within the framework of a set of principles called "Safety assessment principles for nuclear plants"[9].

The role of risk analysis is important in a safety case in that it examines how different scenarios of accidents may develop and how the consequences may be mitigated.

One of the aspects that are necessarily dealt with, is the occurrence of natural and man-made hazards that may affect normal operation on site. *"Earthquakes, flooding, drought, high winds and extremes of ambient temperature are examples of natural hazards which need to be considered. Man-made hazards include the possibility of an aircraft crash on the site and the storage, processing or transport of hazardous materials in the vicinity."*[10]

• ***Risk analysis of aircraft crash in Sellafield***

Safety cases are regularly reviewed to take account of changes to plant and procedures. As far as the risks of aircraft crash are concerned, *"the predicted frequency of aircraft and helicopter crash on or near safety-related plant at the nuclear site"* as well as *"the risk associated with the impacts, including the possibility of aircraft fuel ignition,"* have to be determined[11].

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8 The dispersion of radionuclides after their release in the atmosphere depends on various parameters, including the height reached by the emissions, the wind and/or rain conditions, and can only be described through complex modelling.

9 Health & Safety Executive, *Safety assessment principles for Nuclear plants* www.hse.gov.uk/.

10 Idem.

11 Idem.

The safety case of B215 in Sellafield in particular was *"revised and reissued at the end of 1994 and assessed by the NII"*.[12]

In its February 2000 report on *the storage of liquid high level waste at BNFL, Sellafield,* the NII explained that *"BNFL reviewed the previously generated aircraft crash assessment data and methodology, applicable specifically to the Sellafield site"*. It concluded that *"no significant differences to the previously identified data and methodology were identified"*, without specifying however the criteria used by BNFL to assess this risk and whether *"the most recent crash statistics, flight paths and flight movements for all types of aircraft"* were taken into account.

Commenting on BNFL's study, NII declared itself *"satisfied"* with *"the current aircraft crash hazard assessment"*.[13] According to the NII, BNFL's aircraft crash assessment carried out in 1994 *"concludes that in absolute terms the likelihood of an aircraft impact onto any individual plant is very remote"*, the total impact being below 1×10^{-6}/year.

Nevertheless, the NII recognised in the beginning of the paragraph dealing with the aircraft crash risk that ***"there has been no specific design provision to protect against crashing aircraft"***.

A spokesman for BNFL declared that both reactors and reprocessing plants were *"extremely robust"* and were designed to withstand a plane crash[14]. This statement is in total contradiction with the NII's position and has not been backed up by any published document. BNFL has suggested before that the facilities could withstand a plane crash, for example in commenting on the crash of a light plane in January 1993, only 3 miles from the Sellafield site[15]. The Sellafield spokesman at the time, Alan Irving, explained that the buildings were constructed *"to withstand the most severe impact. They are designed and built to be earthquake-proof"*.

If *"there are two stages in an assessment of the probability of an uncontrolled release caused by an aircraft crash"*:

- first, the assessment of the probability of an aircraft impact; and
- secondly, the conditional probability of the impact leading to an uncontrolled release,

there is no doubt today that, following the 11 September 2001 events, the terrorist threat constitutes a parameter that renders *"previously identified data and methodology"* obsolete. *"Hence the probability of a civil airliner crash threatening nuclear safety"* can no longer be *"concerned low enough to be discounted"*.[16]

As far as regulations are concerned, little has been done to protect nuclear sites efficiently against voluntary aircraft crashes. The UK's civil aviation regulation does include r*estrictions of flying*[17], forbidding flying in the vicinity of certain nuclear installations. For Sellafield in particular, the no-flying zone comprises a 2-mile radius area and a 2,200-feet height. According to aviation sources, Sellafield is located near an air traffic corridor used by airliners linking the UK to the US West Coast[18].

In July 1996 on the other hand, BNFL complained to the Civil Aviation Authority about an air race that took place between Blackpool and the Isle of Man, and which involved *"some 40 piston-engine light aircraft"*. Although they were briefed about the necessity to avoid the no-flying zone near Sellafield, a number of aircraft nevertheless flew in the vicinity of the nuclear site[19].

12 Nuclear Installations Inspectorate, *The storage of liquid high level waste at BNFL, Sellafield,* February 2000
13 Idem
14 Guardian, *Sellafield nuclear plant could be prime target for terrorists*, 18 September 2001.
15 Barrow evening Mail, *Lost in the Mist*, 14 January 1993.
16 Barnes M, *Hinkley Point Public Inquiries*, Vol 6, Ch 47, 1990.
17 Statutory Instrument 2001 No. 1607: the Air Navigation (Restriction of Flying) (Nuclear Installations), which came into force on 11th May 2001.
18 New Scientist, *the Nightmare Scenario,* 13 October 2001.
19 WN, *A-plant anger over air race*, 19 July 1996.

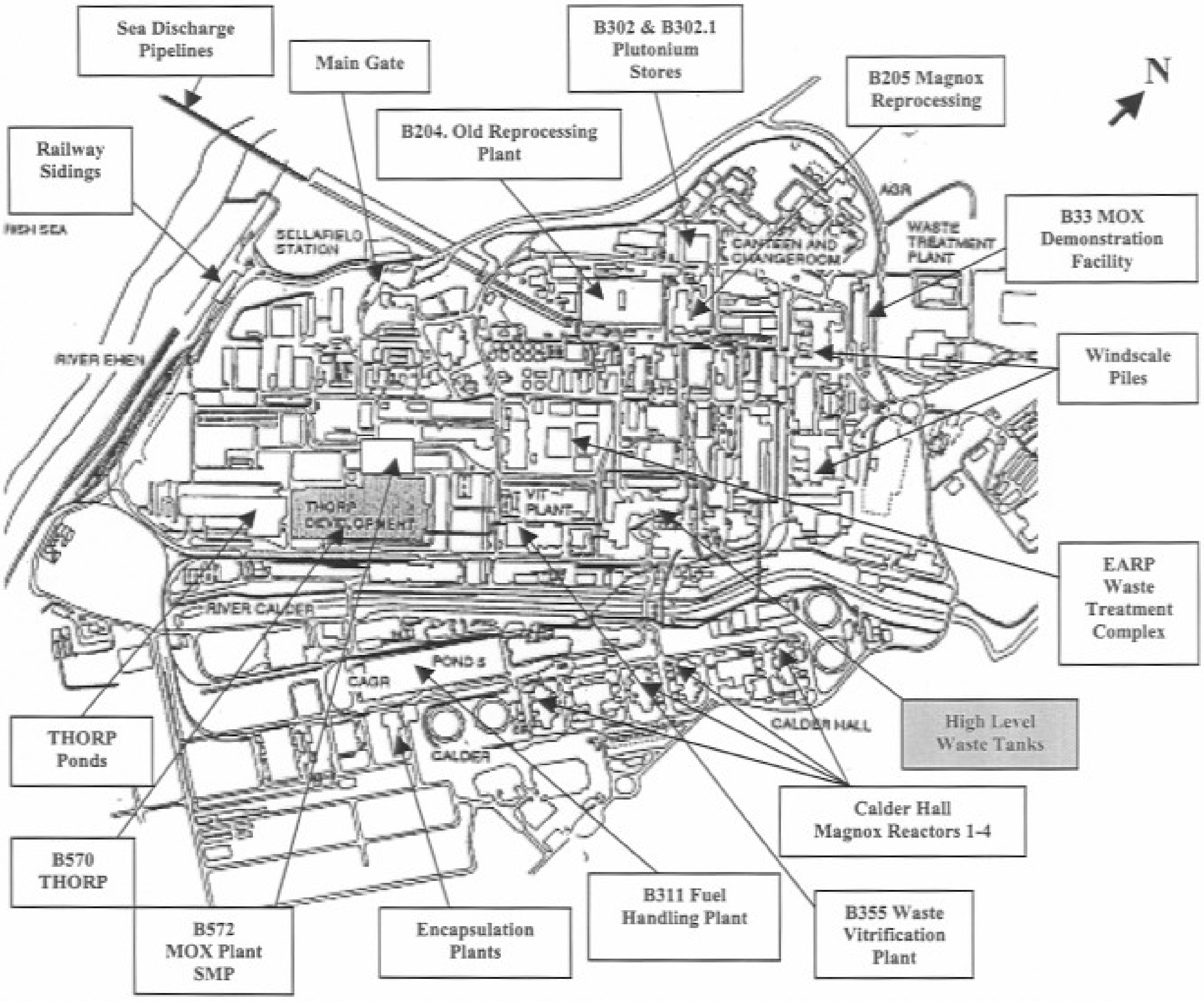
On 25 October 2001, the French government greatly increased the no-fly zone from 100 m to 10 km around the La Hague reprocessing plant and to 5000 feet (1500 m) height[20]. On 26 October 2001, the installation of an unspecified number of CROTALE anti-aircraft missiles started on the La Hague site.

It is extremely surprising that no precise similar measures have been taken yet in order to drastically increase security and protection at Sellafield, by far the most sensitive site in Great Britain.

[20] *Arrêté du 23 octobre 2001 portant création d'une zone interdite temporaire dans la région de La Hague (Manche):*
http://www.legifrance.gouv.fr/citoyen/jorf_nor.ow?numjo=DEFV0102227A

Annex 1:

Presentation of the Sellafield reprocessing facilities

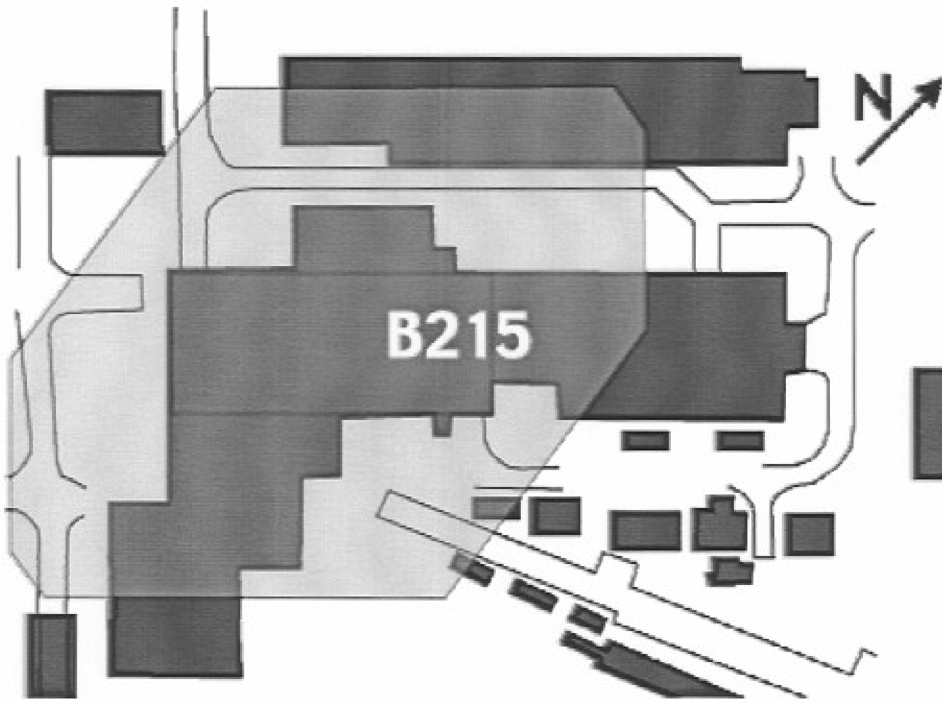


Source: WISE-Paris, based on map transmitted by CORE[21]

[21] *Cumbrians Opposed to Radioactive Environment*

Annex 2:

Area of potential damage in the case of an impact on Sellafield B215 liquid high level waste storage



Sellafield terror attack warning

War on Terrorism: Observer special

Ben Summerskill
Observer

Sunday December 16, 2001

Ministers have been warned that a determined terrorist attempt to fly an aeroplane into the Sellafield nuclear reprocessing plant could not be prevented because of its proximity to transatlantic flight paths.

The warning, from MI5, came after Tornado fighters were scrambled over the plant in response to a reported hijack attempt last month.

'The position at Sellafield is unthinkable,' an intelligence source confirmed. 'If it were hit successfully, everything within 150 miles could go. The position has now been made clear to Ministers.'

'Sellafield is two minutes from the transatlantic flight path. Even if you had a warning that a plane had been hijacked, you would have no real opportunity to intercept a plane flying at 400 or 500 miles an hour. By the time you listened to a call reporting the hijack, it could be all over.'

Within days of receiving the advice two weeks ago, Home Secretary David Blunkett - piloting his new terrorism Bill through the Commons - complained: 'Those who tell me we are not [vulnerable] are the ones who do not have the security and intelligence information which, for my sins, I carry.'

More than 200 flights a day pass within 50 miles of Sellafield in Cumbria. They come not just from Heathrow, but from continental Europe. Two-mile exclusion zones are enforced around the plant, but these only apply to a height of 3,000 feet. Two miles would provide just 14 seconds warning of an approaching aircraft flying at 500 miles an hour.

A spokesman for BNFL, which owns Sellafield, said last night: 'Our buildings are robust and there are the strictest security arrangements. They are built to hold radioactive material.' But a company source conceded that the possibility of an aircraft being deliberately flown into the structures had not been considered when they were constructed.

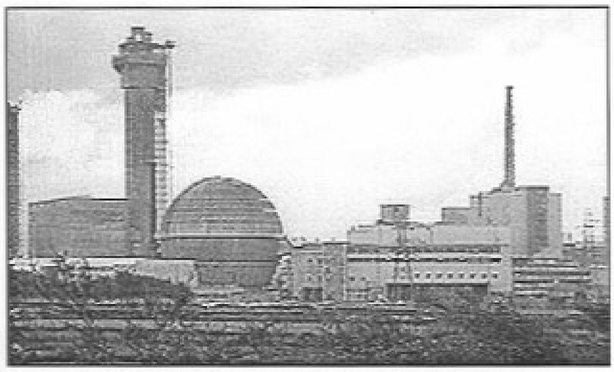
David Learmount, safety editor of Flight International, said: 'You may have slightly more than two minutes, but it wouldn't be more than five. Thankfully, however, if you dive a civil airliner very quickly, it might lose control and miss the building.

'If however it appeared that a plane was intent upon hitting Sellafield, you would have to attempt to blow it out of the sky altogether with the passengers.'

Environmental groups have repeatedly complained about a perceived terrorist threat to Sellafield. Friends of the Earth have claimed that any accident could kill two million people.

Friday, 11 January, 2002, 09:58 GMT

Sellafield terror threat warning



Highly radioactive material is stored at Sellafield

A terrorist attack on the Sellafield nuclear plant would lay most of Northern England to waste, according to a new report.

An area hundreds of miles square could be made uninhabitable by radioactive fallout, warns the US-based academic behind the report.

> **"We know of no specific threat to the Sellafield site"**
>
> **British Nuclear Fuels**

But the findings, which have been handed to the Commons defence committee, were branded "alarmist" by Sellafield's operator British Nuclear Fuels (BNFL).

According to the report's author, Gordon Thompson of the Institute for Resource and Security Studies in Cambridge, Massachusetts, the buildings could not withstand an impact from a passenger jet.

The main threat, it is claimed, comes from a part of the Sellafield plant storing high level radioactive waste, which dates back to the 1950s.

The highly radioactive material in the buildings has to be constantly cooled and stirred to prevent a chain reaction, Dr Thompson claims.

'No secret'

A spokesman for British Nuclear Fuels said Dr Thompson was a "well known opponent of the

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nuclear industry" who had "never had his claims about the releases from these buildings independently verified."

He said it was "no secret" that highly radioactive material was stored at Sellafield but BNFL was in the process of reducing its stocks.

Security at the plant was paramount but there was no evidence that terrorists were planning an attack.

"We know of no specific threat to the Sellafield site," he told BBC News Online.

Irish opposition

Nevertheless, Dr Thompson's report is likely to fuel the arguments of the Irish government, which is bitterly opposed to plans to build a new reprocessing plant at Sellafield.

The Dublin administration had wanted the UK to block the £470m mixed-oxide (Mox) fuel development just across the sea, claiming it would break international laws on sea pollution.

It also claimed the BNFL plant posed safety and security risks, which have been heightened since 11 September.

But a United Nations maritime tribunal rejected the challenge to the plant, which will turn useless plutonium and uranium into a powerful energy source.

Safety assurances

Last week, John Clarke, BNFL's head of environment, health, safety and quality at Sellafield, attempted to reassure the Irish at a special conference on security.

Dealing with the storage of highly active liquid (HAL) waste, Mr Clarke said: "We have now considered what the full impact of a deliberate commercial aircraft crash and the fire that would ensue would be on the HAL facility."

He said BNFL had re-examined its safety arrangements and was satisfied that storage facilities would remain intact.

"Our emergency arrangements would work to mitigate the offsite impact of any radiological release that might result from such an attack," said Mr Clarke.

Sabotage threat

Dr Thompson also claims Sellafield is vulnerable to sabotage of the cooling equipment which keeps the material stable.

One scenario could see a large-scale release of radioactive waste into the Irish Sea, making fishing waters in Western Scotland unusable.

But his concerns were dismissed as unfounded by BNFL.

The Ministry of Defence is understood to have plans in place to deal with terrorist action at Sellafield.

It has declined to comment on security matters.

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