Appraisal of Sustainability of the revised draft Nuclear National Policy Statement:

Radioactive and Hazardous Waste

EN-6: Revised Draft National Policy Statement for Nuclear Power Generation

Planning for new energy infrastructure **October 2010**

Preface:

Appraisal of Sustainability of the revised draft Nuclear National Policy Statement

The Appraisal of Sustainability (AoS), incorporating Strategic Environmental Assessment (SEA), of the revised draft Nuclear National Policy Statement (Nuclear NPS) has been undertaken at a strategic level. It considers the effects of the proposed policy at a national level and the sites to be assessed for their suitability for the deployment of new nuclear power stations by 2025. These strategic appraisals are part of an ongoing assessment process that started in March 2008 and, following completion of this AoS, will continue with project level assessments when developers make applications for development consent in relation to specific projects. Applications for development consents will need to be accompanied by an Environmental Statement having been the subject of a detailed Environmental Impact Assessment (EIA).

The AoS/SEA Reports are presented in the following documents:

AoS Non-Technical Summary

Main AoS Report of revised draft Nuclear NPS
Introduction
Approach and Methods
Alternatives
Radioactive Waste
Findings
Summary of Sites
Technical Appendices

Annexes to Main AoS Report: Reports on Sites
Site AoS Reports
Technical Appendices

All documents are available on the website of the Department of Energy and Climate Change (DECC) at http://www.energynpsconsultation.decc.gov.uk

This document is Annex I (Radioactive and Hazardous Waste) of the Appraisal of Sustainability of the revised draft Nuclear NPS.

This report has been prepared by the Department of Energy and Climate Change (DECC) with expert input from a team of specialist planning and environmental consultancies led by MWH UK Ltd with Enfusion Ltd, Nicholas Pearson Associates Ltd, Studsvik UK Ltd and Metoc plc.

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Section 1: Baseline information for Spent Fuel and Intermediate Level Waste (ILW)

Introduction

A.1. The following information has been used in preparing the appraisal of sustainability of arrangements for managing waste from new nuclear power stations. Information on waste quantities is presented chronologically, with the most recent estimates given last. Unless otherwise noted, the appraisals are based on the most recent estimates of waste quantities, although reference may be made to documents that were based on the estimates current at the time of their preparation.

2006 estimate of waste volume arisings from 10 GW of new nuclear installed capacity

A.2. The following data was presented by the Sustainable Development Commission[1], from original work completed by CoRWM[2].

Reactor type	Number	Packaged volume (m^3)		
		Fuel in SKB canisters	ILW	LLW
AP 1000	10	31,900	9,000	80,000
UK-EPR	7	21,000	13,000	100,000

2006 estimates of waste volume increases from 10 x AP1000 reactors

A.3. These data were originally presented by the Sustainable Development Commission[3].

Reactor type	Number	Packaged volume (m^3)		
		Spent fuel	ILW	LLW
Baseline	-	8,150	353,000	2.48 million + 37,200 (non LLWR)
AP 1000	10	31,900	9,000	80,000
% increase	-	390	2.5	3

[1] The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC (March 2006) page 50 - 54
[2] Davies, W. Inventory Summary Information, CoRWM Document No 1531, Version Final (2006).
[3] The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC (March 2006) page 50 - 54

A.4. Waste volume increases from 10 x AP 1000 reactors using revised data presented by the Sustainable Development Commission[4].

Reactor type	Number	Packaged volume (m^3)		
		Spent fuel	ILW	LLW
Baseline	-	11,200	364,000	n/a
AP 1000	10	31,900	9,000	-
% increase	-	285	2.5	-

2007 Radioactive Waste and Materials Inventory

A.5. The following information was presented in the Government's Managing Radioactive Waste Safely White Paper[5]

Materials	Packaged Volume		Radioactivity	
	Cubic Meters	%	Terabequerels	%
HLW	1,400	0.3	36,000,000	41.3
ILW	364,00	76.3	2,200,000	2.5
LLW (not for LLWR)	17,000	3.6	<100	0.0
Spent nuclear fuel	11,200	2.3	45,000,000	51.6
Plutonium	3,300	0.7	4,000,000	4.6
Uranium	80,000	16.8	3,000	0.0
Total	**476,900**	**100**	**87,200,000**	**100**

2009 estimates of Spent Fuel volumes

A.6. The Consultation on the Future of Nuclear Power contained some figures on the impact of a new build programme on the "footprint" of geological disposal facilities. In relation to spent fuel, it was estimated that a new build programme equivalent to 10 AP-1000s would increase the footprint of a dedicated HLW/spent fuel[6] geological disposal facility by around 90%[7].

A.7. More recent work by NDA means it is now possible to update this estimate. The NDA has, as part of their disposability assessments under the Generic Design Assessment (GDA) process[8,] which reported its

[4] The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC (March 2006) page 50 - 54

[5] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://mrws.decc.gov.uk/ Page 20

[6] In addition to spent fuel, the legacy inventory also includes a substantial amount of High Level Waste (HLW), which is the result of the reprocessing of spent fuel. HLW will also need to be disposed of in a GDF.

[7] The Future of Nuclear Power: Consultation document 2007, page 135. http://www.berr.gov.uk/files/file39197.pdf

[8] Through the GDA process the nuclear regulators are assessing the safety, security and environmental impact of power station designs, including the quantities and types of waste that are likely to arise, their suitability for storage, transport and their disposability. More information about GDA is available at the HSE's new nuclear power stations website http://www.hse.gov.uk/newreactors/index.htm

findings to the "Requesting Parties"[9], produced estimates for the lifetime spent fuel arisings for the new nuclear power station designs being assessed in the GDA process[10]. NDA has considered the potential impact on the size of a GDF of the disposal of spent fuel from a single new nuclear reactor and from a 10GW new nuclear programme. 10 GW equates to 9 AP-1000 reactors or 6 EPR reactors.

A.8. The NDA has estimated that an AP-1000 operating for 60 years would give rise to an estimated 640 disposal canisters[11], requiring an area of approximately 0.11 km^2 for the associated disposal tunnels. A fleet of nine such reactors would require an area of approximately 1 km^2, excluding associated service facilities. This represents approximately 6% of the area required for legacy HLW and spent fuel per reactor, and approximately 55% for the illustrative fleet of nine AP-1000 reactors.

A.9. The NDA has estimated that an EPR operating for 60 years would give rise to an estimated 900 disposal canisters, requiring an area of approximately 0.15 km^2 for the associated disposal tunnels. A fleet of six such reactors would require an area of approximately 0.9 km^2, excluding associated service facilities. This represents approximately 8% of the area required for legacy HLW and spent fuel per reactor, and approximately 50% for the illustrative fleet of six EPR reactors.

2009 estimate for ILW volumes

A.10. The 2007 consultation on the Future of Nuclear Power contained estimates by Nirex that a new build programme equivalent to 10 AP-1000s would increase the quantity of ILW by around 3%[12].

A.11. More recent work by NDA means it is now possible to update this estimate The NDA has, as part of their disposability assessments under the GDA process produced estimates for the lifetime ILW arisings for the new nuclear power station designs being assessed in the GDA process.

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[9] The term "requesting party" is used in relation to the GDA process to identify the organisation requesting acceptance for a design through GDA. This request will normally originate from a reactor vendor, however this may also be done as a vendor/operator partnership. Consequently, the term `requesting party' is used to identify the organisation seeking the design acceptance and to distinguish it from a nuclear site licence applicant

[10] Summary Disposability Assessment for the AP-1000. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-DA-for-Wastes-and-SF-arising-from-Operation-of-APPWR-October-2009.pdf. Summary Disposability Assessment for the EPR. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-Disposability-Assessment-for-Wastes-and-Spent-Fuel-arising-from-Operation-of-the-EPWR.pdf

[11] The reference design currently being used by NDA RWMD for the purposes of estimating the costs of a geological disposal facility envisages spent fuel being encapsulated in copper canisters prior to disposal. The capacity of a copper canister is four PWR spent fuel assemblies. See page 71 of the MRWS White Paper for more on this.

[12] The Future of Nuclear Power page 135.

A.12. The volume of packaged ILW (both operational and decommissioning) produced by an EPR operating for 60 years is estimated to be in the range 2097-3651m^3 dependent upon the packaging system used[13]. For an AP-1000 operating for 60 years, the volume of packaged ILW produced is estimated[14] to be 3450m^3

A.13. NDA has considered the potential impact on the size of a GDF of the disposal of ILW from a single new nuclear reactor and from a 10GW new nuclear programme. 10 GW equates to 9 AP-1000 reactors or 6 EPR reactors. The volume of ILW for disposal is subject to some variation depending on assumptions regarding packaging and conditioning technologies that might be adopted by future operators, but NDA has concluded that in all cases the necessary increase in the GDF "footprint area" is small.

A.14. For the AP-1000 the necessary increase in the GDF "footprint area" corresponds to approximately 65m of disposal vault length per reactor. This represents approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of 9 AP-1000 reactors.

A.15. The findings are similar for the EPR, where NDA has calculated that each EPR would require an additional 60m of disposal vault length, representing approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of six EPR reactors.

[13] Disposability Report for the EPR Tables B3-B6
[14] Disposability Report for the AP-1000 Table B1

Section 2: Policy and Planning Review

Radioactive Waste – International

EU (1957) European Atomic Energy Community (EURATOM treaty) subsequently supported by Council Directive 96/29/EURATOM (laying down basic safety standards for the protection of health of workers and the general public against the dangers arising from ionising radiation
This treaty was drafted to address issues relating to nuclear power. Article 37 of the treaty specifically requires the submission of general information to the European Commission on plans to manage the disposal of radioactive wastes so that an opinion on the effect of those plans on other member states can be given. The directive defines dose limits for workers; 100mSv in a consecutive 5 year period and a maximum effective dose of 50mSv in any single year. Member states may decide an annual limit. The directive establishes an effective dose limit for members of the public; 1mSv (annual).

Commission Recommendation of 6 December 1999 on the application of Article 37 of the Euratom Treaty, 1999/829/Euratom
This recommendation was drafted to provide additional detail on the application of Article 37. The document recommends that the disposal of radioactive waste within the meaning of Article 37 of the treaty should cover planned disposal and accidental releases within identified operations including the operation of nuclear reactors, the processing and storage of radioactive wastes, the emplacement above or under the ground of radioactive wastes without the intention of retrieval. Annexes 1-3 provide an overview of the general data required in an Article 37 submission for various operations. Annex 4 provides a standard form for modifications to an existing plan for the disposal of radioactive waste.

Council Directive 2006/117/Euratom of 20 November 2006 on the Supervision and Control of Shipments of Radioactive Waste and Spent Fuel
This Directive applies to the shipment of radioactive waste between member states and into and out of the European Community. The holder of the radioactive waste must submit an application for an authorisation to the competent authorities of the country of origin (the EA for the UK). These competent authorities then send the application for approval to the competent authorities of the country of destination and any transit countries. This Directive has been implemented in the UK by the The Transfrontier Shipment of Radioactive Waste and Spent Nuclear Fuel Regulations 2008.

OSPAR Commission: Protecting and Conserving the North East Atlantic and its resources
The OSPAR Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic. Work under the Convention is managed by the OSPAR Commission, made up of representatives of the Governments of 15 Contracting Parties and the European Commission, representing the European Community. *OSPAR's mission is to conserve marine ecosystems and safeguard human health in the North-East Atlantic by preventing and eliminating pollution; by protecting the marine environment from the adverse effects of human activities; and by contributing to the sustainable use of the seas.*

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997
The objectives of the convention are to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management through enhancement of national measures and international co-operation. To ensure that during all stages of the spent fuel and radioactive waste management there are effective defences against potential hazards to prevent accidents and where applicable mitigate the consequences of such accidents. The convention came into force in June 2001.

Convention on Nuclear Safety 1994
The objective of the Convention is to achieve and maintain a high level of nuclear safety worldwide, to establish and maintain effective defences in nuclear installations against potential radiological hazards, and to prevent accidents with radiological consequences.

Council Directive 2008/790-final/Euratom on Nuclear Safety
In July 2009 the EU adopted a new Directive on Nuclear Safety. The aim of the Directive is to ensure continuous improvement in the management of the health and safety risks associated with the management of civil nuclear facilities. UK Government are currently undertaking a scoping exercise to ensure that the relevant domestic legislation and organisational infrastructure is in place to enable full implementation of the Directive by 2011 – the initial scoping exercise has identified that most, if not all, the requirements of the Directive are already being met in the UK.

Radioactive Waste – National

Review of Radioactive Waste Management Policy, Final Conclusions, Cm 2919, 1995
This White Paper sets out the Governments conclusions of their review of radioactive waste management policy at that time in 1995. Note: Some parts of the policy reviewed in 1995 have changed, for example: In 2007 the Government published their Policy for Long-Term Management of Solid Low Level Radioactive Waste in the United Kingdom; and in 2008 the Managing Radioactive Waste Safely White Paper was published, setting out the Government's policy for the management of higher activity radioactive wastes.

The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000
Sets out dose limits for exposures to members of the public from ionizing radiation ensuring that they are kept ALARP and states maximum doses to individuals which may result from a defined source, for use at the planning stage in radiation protection. These limits are:

(a) 0.3 millisieverts per year from any source from which radioactive discharges are first made on or after 13th May 2000; or (b) 0.5 millisieverts per year from the discharges from any single site.

The Ionising Radiation Regulations 1999 (IRR99)
IRR99 requires employers to keep exposure to ionising radiations as low as reasonably practicable. Exposures must not exceed specified dose limits. Restriction of exposure should be achieved first by means of engineering control and design features. Where this is not reasonably practicable employers should introduce safe systems of work and only rely on the provision of personal protective equipment as a last resort.

Policy for Long-Term Management of Solid Low Level Radioactive Waste in the United Kingdom
In March 2007 the UK Government published a new Policy for the Long Term Management of Solid Radioactive Low Level Waste introducing a more flexible and fit-for-purpose framework for LLW management centred on the application of the waste management hierarchy. The purpose of the Government LLW Policy statement was to provide a high-level framework setting out principles for the long term management of LLW in the UK. The manner in which the policy will be taken forward is via UK-wide strategies and site-based initiatives. The policy required that NDA develop a UK-wide strategy for LLW generated by the nuclear-industry. The NDA published the *UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry* on 26 August 2010.

W&NM/PP/004, NDA Waste and Nuclear Materials Department Position Paper, Introduction to Low Level Waste Issues, Issue 1, 14/03/09
Paper provides an overview of the issues associated with the management of Low Level Waste, sets out the definition of low level waste and outlines NDA role in the development of low level waste strategy.

NDA Low Level Waste: Nuclear Industry LLW Strategy, 2010
This document is the first UK strategy for solid radioactive LLW arising from the nuclear industry. The document has been developed in conjunction with LLWR Ltd. (Site Licence Company for the Low Level Waste Repository at Drigg, Cumbria). A key driver for the strategy is the requirement to preserve capacity at the only national engineered LLW waste disposal facility; Low Level Waste Repository near Drigg, Cumbria.

Nuclear Installations Act 1965 (as amended)
Whist the Nuclear Installation Act 1965 provides the framework for the management of radioactive matter, it is the Nuclear Site Licence Conditions (SLC) that stipulate both the general and specific requirements for the management of radioactive waste. The following SLC apply specifically to radioactive waste: • Licence Condition 32 – Accumulation of Radioactive Waste • Licence Condition 33 – Disposal of Radioactive Waste • Licence Condition 34 – Leakage and escape of radioactive material and radioactive waste

Radioactive Substances Act 1993[15] and Environmental Permitting Regulations 2010
The Radioactive Substances Act 1993 defines radioactive waste as waste, which consists wholly, or partly of: • A substance or article which, if it were not waste, would be radioactive material, or, • A substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity with radioactive material The Environmental Permitting Regulations 2010 is the principle environmental legislation regulating the accumulation and disposal of radioactive waste. Sites that accumulate and dispose of radioactive waste require an authorisation from the Environment Agency. The authorisation also stipulates the waste disposal route.

[15] Radioactive Substances Act 1993 applies to Scotland and Northern Ireland. The Environmental Permitting Regulations 2010 is the principle environmental legislation in England and Wales.

The Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment Regulations 2009 (CDG09) (SI 1348)
The Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment Regulations 2009 (SI 1348) details the requirements for the transport of dangerous goods by road and rail. The CDG2009 implement the application of the ADR[16] and RID[17] in the UK. This regulation references directly out to the ADR and RID for the specific regulations that are applicable to dangerous goods transport for road and rail.

The Justification of Practices Involving Ionising Radiation Regulations 2004 (SI 1769)
These Regulations transpose into national legislation the requirements of Council Directive 96/29/Euratom that Member States ensure that all new classes or types of practice resulting in exposure to ionising radiation are justified in advance of being first adopted or first approved by their economic, social or other benefits in relation to the health detriment they may cause.

The Radioactive Material (Road Transport) Act 2002
These regulations regulate all road transport of radioactive material and are based on the International Atomic Energy Agency's (IAEA) Regulations for the Safe Transport of Radioactive Materials 1996 Safety Guide TS-G-1.1 (ST-2).

The Radiation (Emergency Preparedness and Public Information) Regulations 2001
This provides protection to members of the public from emergencies that might arise from work with ionising radiations. A radiation emergency is defined as an accident or event in which a member of the public receives an effective dose greater than 5 mSv within a period of 1 year.

The Planning and Compulsory Purchase Act 2004
The Planning and Compulsory Purchase Act 2004 introduced changes to the planning system; in particular development plans and radically changes the processes by which they are produced.

[16] Council Directive 2006/89/EC amends Council Directive 94/55/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by road (known as ADR).
[17] Council Directive 2006/90/EC amends Council Directive 94/49/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by rail (known as RID).

Previously a Minerals and Waste Planning Authority had the statutory duty to produce minerals and waste local plans. The Act introduced the requirement of Local Development Frameworks (LDFs) and as a result Minerals and Waste Development Framework (MWDF) was required.

The MWDF of Local Development Documents (LDDs), which includes Development Plan Documents (DPDs) form part of the statutory development plan and Supplementary Planning Documents (SPDs) which expand policies set out in a DPD or provide additional detail. The MWDF will also include a Statement of Community Involvement (SCI), the Minerals and Waste Development Scheme (MWDS) and the Annual Monitoring Report.

The Minerals and Waste Development Scheme (MWDS) is the first step towards the production of the Minerals and Waste Development Framework. The MWDS identifies the individual documents that will collectively make up the MWDF and the timetable for producing them. Government specify that the timetable must be clear and realistic and give priority to producing the documents that will actually contain the planning policies, rather than those containing supplementary information.

The purpose of the MWDS is to set out a clear programme for the production of LDDs over the next three years.

DECC (2009), UK Strategy for Radioactive Discharges 2001 - 2020

The 2009 Strategy establishes a framework for discharges from UK installations over the next 20 years and provides the basis for the review of future discharge authorisations and planning by nuclear operators. The aims of the strategy are:

- Progressive and substantial reduction of radioactive discharges and discharge limits, to achieve the strategy targets
- Progressive reduction of human exposure to ionising radiation arising from radioactive discharges, such that a representative member of a critical group will be exposed to an estimated mean dose no greater than 0.02 mSv per year from liquid radioactive discharges to the marine environmental made from 2020 onwards.
- Progressive reduction of total activity of radionuclides in the marine environment resulting from radioactive discharges, such that by 2020 they add close to zero to historic levels.

The Strategy, which is an update of the 2002 Strategy, implements the agreements reached at a the 2002 Ministerial meeting (and subsequent meeting of the OSPAR commission) and provides the UK contribution to achieving the aims of

the OSPAR Strategy as it relates to the discharge of radioactive substances in to the North East Atlantic

Radioactive Waste – Regional

Cumbria Waste And Minerals, Core Strategy, March 2008
The strategy accounts for the nuclear facilities located in West Cumbria; specifically the Low Level Waste Repository near Drigg and Sellafield. Chapter 8 of the document addresses radioactive wastes and recognises that the strategy document has been prepared during a period when national policy for long term management of radioactive waste is evolving. The strategy notes that the acceptance of a national role for the repository is on the basis of the NDA's and the site operator's initiatives to reduce the proportions of the waste consigned to storage. This strategy promotes the application of the waste management hierarchy to consigning sites and the repository itself.

Hazardous Waste

Council Directive (91/689/EEC) of 12 December 1991 on Hazardous Waste
Sets out requirements for the controlled management of hazardous (special) waste. The Regulations set out procedures to be followed when disposing of, carrying and receiving hazardous waste.

Hazardous Waste (England and Wales) Regulations 2005 SI 894
Details requirements for controlling and tracking the movement of hazardous waste and bans mixing different types of hazardous waste.

Hazardous Waste (England and Wales) (Amendment) Regulations 2009 SI 507
Amends 2005/894 by increasing the maximum limit of hazardous waste that can be produced in any year without registering with the regulator from 200kg to 500kg. Also explains parts of the 2005 regulations that were not clear.

List of Wastes (England) Regulations 2005 SI 895
Provides the European Waste Catalogue list of codes used to classify wastes.

List of Wastes (England) (Amendment) Regulations 2005 SI 1673
Amends 2005/895 to correct minor errors.

Environmental Permitting (England and Wales) Regulations 2007 SI 3538
Introduces a new system for environmental permits for industrial activities and waste operations, including landfill and waste incineration and sets out the powers, functions and duties of the regulator.

Section 3 Appraisal Matrices: Spent Fuel

Notes on Appraisal approach

1. The discussion of potential effects and mitigation possibilities includes: the effects of waste management at nuclear power station sites; transport offsite; and effects at the site for final disposal of the waste where applicable.
2. The summary of potential effects for each topic includes the effects of waste management at nuclear power station sites and transport offsite only.
3. The summary of potential effects is carried to the summary tables for each waste type that are presented in Section 6 of the Main AoS.
4. It is assumed that no Spent Fuel is transported from site until after the end of the Operational phase.

Key to Appraisal				
Key to appraisal of Strategic Effects:			**Abbreviations:**	
Significance		**Category of effect**	**Timescale**	
++	Major Significant	Development actively encouraged as it would resolve an existing sustainability problem. Effect considered to be of national/ international significance.	C	Construction stage
+	Minor Significant	No Sustainability constraints and development acceptable. Effect considered to be of national/ international significance.	O	Operation stage
0	No significance	Neutral effect	D	Decommissioning stage
-	Minor Significant	Potential sustainability issues; mitigation and / or negotiation possible. Effect considered to be of national/ international significance.	**Likelihood**	
--	Major Significant	Development problematical because of known sustainability issues; mitigation or negotiation difficult and/ or expensive. Effect considered to be of national/ international significance.	H	High Likelihood
?	Uncertainty	Where the significance of an effect is particularly uncertain, for example because insufficient information is available at the plan stage to fully appraise the effects of the development or the potential for successful mitigation, the significance category is qualified by the addition of '?'.	M	Medium Likelihood
			L	Low Likelihood

Spent Fuel: Air Quality

AoS Objective:

To avoid adverse impacts on air quality

Guide questions:

Will it result in the release of radionuclides that may adversely affect human health or biodiversity?
Will it contribute to an increase in the number or expansion of Air Quality Management Areas (AQMAs)?

Potential Receptors:

- Local populations (at the power station site and at a Geological Disposal Facility (GDF))
- Regional and National Populations (transport)
- Sensitive habitats identified in site specific reports (at the power station site and at a GDF)

Potential Effects and Mitigation Possibilities:

International / National / Transboundary

1. UK regulation permits the shipment of spent fuel overseas, provided that shipments are in accordance with an authorisation approved by the competent authorities concerned. It is anticipated that spent fuel from new nuclear power stations will be subject to interim storage at the reactor site and subsequent disposal at a UK located GDF and will not be exported internationally.

2. All relevant Euratom Treaty[18] requirements are transposed into UK law. Article 37[19] of this treaty requires each member state to provide the Commission with information relating to any plan for the disposal of radioactive waste to enable each member state to determine if this will result in radioactive contamination of their environment (water, soil or airspace). The development of new nuclear power station sites, interim storage facilities and a GDF will require an Article 37 submission.

Regional/ Local

1. The potential for direct impacts on air quality associated with spent fuel is related to radioactive emissions (waste gases, mists and particles). The potential for indirect impacts are associated with ancillary processes such as emissions from the transport of wastes. Spent fuel is initially extremely radioactive and highly toxic and emits considerable heat from the radioactive decay of short-lived radionuclides[20].

2. The UK has an established regulatory regime supported by independent regulatory bodies; the Nuclear Installations Inspectorate (NII) and Environment Agency (EA). All facilities, including interim storage arrangements at reactor sites (whether dry or wet) and at a GDF itself will be subject to comprehensive regulation by the NII and impacts on air quality subject to appropriate preventative and mitigation measures. A GDF concept will be designed to ensure that discharges will be subject to authorisation by the EA and fall within constraints and limits:

   The Managing Radioactive Waste Safely (MRWS) White Paper stated that "The facility will be designed so that natural and man-made barriers work together to minimise the escape of radioactivity. It is inevitable that some radioactivity from the facility will eventually reach the surface. But the disposal facility will be designed to ensure that risks arising from such release would be insignificant compared to the levels of radioactivity all around us in the environment from natural background sources. The natural process of radioactive decay over time will assist this aim."[21.]

[18] European Union European Atomic Energy Community (EURATOM treaty), (1957).
[19] If an EU Member State alters the way in which it plans to dispose of radioactive waste, seeks to reduce restrictions on discharges, or has a new facility which may increase emissions it must make a submission to the Commission seeking an opinion on the proposals.
[20] Baldwin, B., Chapman, N. and Neall, F. Report for the UK Nuclear Decommissioning Authority, Geological Disposal options for High-Level Waste and Spent Fuel, Version: Final (January 2008).
[21] MRWS White Paper page 27 http://mrws.decc.gov.uk/

There is the potential for minor negative effects on air quality but ALARP[22] will apply.

3. Radioactive emissions from operational sites are authorised by the Environment Agency (EA) under the Environmental Permitting Regulations 2010 (EPR 10). Emissions are required to be ALARA[23] and monitored and managed in accordance with documented arrangements approved by the EA. An Article 37 submission, a requirement of the Euratom Treaty, which seek to understand the impact of radioactive emissions on EU member states, will be required for both a GDF and for new nuclear power station sites, in which interim storage facilities will be part of a wider submission.

4. A RSA authorisation requires the site operator to apply Best Practical Environmental Option (BPEO), Best Practicable Means (BPM) or Best Available Technique (BAT) to minimise waste arisings[24]. Implementation of these techniques to new nuclear power stations will seek to minimise spent fuel volumes and secondary waste arisings, including emissions to air. The reactor designers indicate that these modern designs generate less spent fuel than previous designs[25]. It is expected that operators of new nuclear power stations will be responsible for establishing their own interim storage arrangements. British Energy[26] has recently completed a BPEO on interim storage for spent fuel and a BPM study.. The BPEO considered four options for managing spent fuel, which are: reprocessing, a new wet store fuel pond, a dry store in casks and a dry store in vaults. Whilst each option may be considered at new nuclear power station sites and have a different impact on air quality this will be determined by assessment of each option by the developer. Preferred options will be required to meet the prevailing regulatory framework. Following the studies and consultation British Energy submitted an application to DECC in February 2010 for planning consent to construct and operate a dry fuel store at Sizewell B.

[22] As Low as Reasonably Practicable (ALARP). To satisfy this principle, measures necessary to reduce risk must be taken until the cost of these measures whether in money, time or trouble, is disproportionate to the reduction of risk.
[23] As Low As Reasonably Achievable (ALARA). The ALARA principle is contained in the Euratom Basic Safety Standards Directive 96.29, which is transposed into UK Law. Essentially, it means that all reasonable steps should be taken to protect people. In making judgement, factors such as the costs involved in taking protection measures are weighted against benefits obtained, including the reduction in risks to people.
[24]The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or least damage to the environment as a whole, at acceptable cost, in the long term well as in the short term. BPM is the term used by the environment agencies in authorisations issued under RSA 1993. It requires operators to take reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposal of radioactive waste so as to achieve a high standard of protection for the public and the environment. The EA is proposing to adopt Best Available Technique (BAT) to replace BPEO / BPM.
[25] Health & Safety Executive, Reactor Designs, www.hse.gov.uk/reactors/reactordesigns.htm, accessed 16/03/2009
[26] British Energy, Managing spent fuel at Sizewell B, Finding the Right Interim Storage beyond 2005, http://www.british-energy.com/documents/Spent_Fuel_brochure.pdf, accessed 28/04/09 (2005).

5. Spent fuel will not be present during construction; hence no effect on air quality is expected.

6. The MRWS White Paper[27] gives examples of a number of engineered barriers to prevent radioactive emissions to the outside environment during interim storage of waste packages. Such barriers would include the waste form itself as the primary barrier, the waste container as the secondary barrier, control of the store environment is the tertiary barrier and the store structure itself is the final layer of protection. Together these barriers would minimise the impact on air quality.

7. Heat generated in interim storage facilities established on new nuclear power station sites for spent fuel will be dissipated into the atmosphere. Ventilation may be mechanical but is typically passive. The potential impact of such heat emissions on local air quality is considered negligible.

8. There will be transport emissions associated with the movement of spent fuel to a GDF. The potential impact of such emissions are expected to be minor when considered in terms of national transport emissions and could be partially mitigated by the adoption of rail for the movement of spent fuel. The development of a GDF and a new nuclear power station site's interim storage facility would be expected to consider the transportation options. Air pollution can be minimised and controlled through working in accordance with good site environmental practices and management through the use of Construction Environmental Management Plans.

9. The design of a GDF will need to consider the properties of the spent fuel from the new nuclear stations, and the volume of spent fuel from new nuclear power stations could significantly affect the size of the facility. In order to accommodate spent fuel from new nuclear power stations, a GDF will be larger than a facility designed solely for legacy wastes. The impact of a GDF on air quality is more appropriately considered within a specific impact assessment once the location and design of such a facility is finalised. Emissions to air from spent fuel disposal at an operational GDF have the potential for negative effects on local air quality. A GDF will be an "engineered underground containment facility" and will be designed to minimise the risks from radioactivity[28].

10. Spent fuel from a new nuclear power station may contain higher concentrations of readily releasable radionuclides from the

[27] MRWS White Paper page 24
[28] MRWS White Paper page 27

volatile fission products and this should be taken into account in developing a GDF. Studies completed in support of the EPR-type[29] reactor have indicated that there is suitable shielding available to enable safe handling of spent fuel and confirm that there is existing engineered barrier technology available to ensure safe disposal of waste including readily releasable radionuclides in spent fuel.

11. The carriage of radioactive materials, including spent fuel is governed by International agreements and implemented through UK regulations. The applicable UK legislation is the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 that replaced the earlier 2007 version. The UK regulations transpose Commission Directives 2006/89/EC[30] and 2006/90/EC[31] into UK law. It is assumed that spent fuel will be transported to a GDF in a shielded transport flask designed to minimise external dose and provide containment of radioactivity compliant with regulatory requirements.

There is potential for the decommissioning of interim storage facilities for spent fuel to have negative effects on air quality. Demolition of structures including ponds has the potential to generate contaminated dusts etc. New facilities design will consider decommissioning to ensure waste arisings are minimised. BPEO/BPM or BAT[32] studies supporting decommissioning activities will ensure waste arisings including emissions to air are minimised.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	0	-?
Likelihood	H	H	H

Potential Effects	Potential Mitigation and Monitoring
• Potential for minor negative effects on local air quality associated with construction and decommissioning of interim storage facilities for spent fuel, associated with non-radioactive emissions from construction plant and vehicles.	• New nuclear power station site specific impact assessments • Engineered barriers in interim storage

[29] Health & Safety Executive, Reactor Designs, www.hse.gov.uk/reactors/reactordesigns.htm, accessed 16/03/2009 (2009).
[30] Council Directive 2006/89/EC amends Council Directive 94/55/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by road (known as ADR).
[31] Council Directive 2006/90/EC amends Council Directive 96/49/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by rail (known as RID).
[32] The EA is proposing to replace BPEO / BPM with Best Available Technique (BAT)

• Transport associated with the movement of spent fuel to disposal facilities has the potential for minor negative effects on air quality. • Radioactive emissions associated with operational interim storage facilities will have a negligible effect and will be managed by engineered containment and compliance with regulations.	facilities • Statutory monitoring associated with authorisations established at operational facilities • Annual pollution inventory at new nuclear power station sites • Use of rail transport to minimise emissions

Spent Fuel: Biodiversity and Ecosystems

AoS Objective:

to avoid adverse impacts on the integrity of wildlife sites of international and national importance
to avoid adverse impacts on valuable ecological networks and ecosystem functionality
to avoid adverse impacts on Priority Habitats and Species including European Protected Species

Guide questions:

Will it result in the loss of habitats of international/national importance?
Will it affect other statutory or non-statutory wildlife sites?
Will it result in harm to internationally or nationally important or protected species?
Will it adversely affect the achievement of favourable conservation status for internationally and nationally important wildlife sites?
Will it affect the structure and function/ecosystem processes that are essential to restoring, securing and/or maintaining favourable condition of a feature or a site?
Will the proposal enable the BAP targets for maintenance, restoration and expansion to be met?
Will the proposal result in changes to coastal evolution that is otherwise needed to sustain coastal habitats?
Will it result in the release of harmful substances for example oil, fuel and other pollution into water bodies which could affect aquatic ecosystems?
Will it result in the accidental migration of radionuclides which could harm aquatic or terrestrial ecosystems?
Will it result in changes to stream hydrology and morphology that could affect aquatic or terrestrial ecosystems?
Will it result in thermal discharges that could adversely affect aquatic ecosystems?
Will it result in soil contamination that could damage aquatic or terrestrial ecosystems?

Potential Receptors:

- Local, Regional, European and International environment

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. The European Directive (92/43/EEC) on the Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive) protects habitats and species of European nature conservation importance by establishing a network of internationally important sites designated for their ecological status. These are referred to as Natura 2000 sites or European Sites, and comprise of Special Protection Areas[33] (SPAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and European Offshore Marine Sites (EOMS) designated under the EC Habitats Directive. Potential SPAs (pSPAs) and Ramsar sites are included in the assessment in line with Government policy. The draft Nuclear NPS has been assessed in accordance with the European Habitats Directive. The findings have been incorporated into the AoS Report and the details of the Habitats Regulations Assessment (HRA) are reported separately. 2. Work is ongoing within the EU on methodologies to assess the impact of ionising radiation on biota. They include: • ERICA[34] (Environmental Risk from Ionising Contaminants: Assessment and Management) will provide an integrated approach to scientific, managerial and societal issues concerned with the environmental effects of contaminants emitting ionising radiation, with emphasis on biota and ecosystems. • FASSET[35](Framework for assessment of environmental impact of ionising radiation in major European ecosystems) includes: source characterisation; description of seven major European ecosystems; selection of a number of reference organisms on the basis of prior ecosystem and exposure analysis; environmental transfer analysis; dosimetric considerations and effects analysis; • PROTECT[36] (Protection of the Environment from Ionising Radiation in a Regulatory Context) will evaluate the practicability and relative merits of different approaches to protection of the environment from ionising radiation and compare these with methods used for non-radioactive contaminants.

[33] Classified under the EC Birds Directive 1979.
[34] http://www.ceh.ac.uk/protect/ERICAdeliverables.html
[35] http://www.ceh.ac.uk/protect/FASSETdeliverables.html
[36] http://www.ceh.ac.uk/protect/EPICdeliverables.html

By understanding the full environmental impacts of ionising radiation on the environment an improved impact assessment can be developed. It is expected that these methodologies will be used to give a more accurate estimate of the impact of new build power stations than previously possible for existing nuclear facilities.

3. Article 37 of the Euratom Treaty[37] requires each member state to provide, for any plans for disposal of radioactive waste, details of the potential for radioactive contamination of water, soil or air space of another member state. Article 13 of the Basic Safety Standards Directive[38] issued under Euratom limits the effects of such contamination by imposing a limit on public dose of 1mSv. These measures will also tend to limit radiation doses to flora and fauna (except in areas of extremely low human population density).

4. Storage and disposal of spent fuel is assumed to be in the UK; therefore no direct effects on habitats outside the UK are anticipated. As previously mentioned, the draft Nuclear NPS has been assessed in accordance with the European Habitats Directive. The findings have been incorporated into the AoS Report and the details of the Habitats Regulations Assessment (HRA) are reported separately.

Regional/ Local

1. Radioactive discharges resulting from interim storage of spent fuel on the site of a new nuclear power station, and geological disposal of spent fuel in a GDF, will be controlled by authorisations issued by the EA under the Environmental Permitting Regulations 2010. This ensures that doses from all sources to members of the public are less than 1mSv per annum; this will also tend to limit radiation doses to flora and fauna (except in areas of extremely low human population density). As the annual public doses received from the existing water cooled power station at Sizewell B, where spent fuel is currently in interim storage, are <0.005mSv[39] it is unlikely that there will be any measurable effects on biodiversity as a result of radioactive discharges from new build Pressurised Water Reactors.

[37] European Union European Atomic Energy Community (EURATOM treaty), (1957).
[38] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[39] EA, SEPA, FSA, EHSNI, Radioactivity in Food and the Environment, 2008, RIFE-14, (2009).

2. The interim storage of spent fuel at new nuclear power station sites will require the construction of an appropriate engineered facility to minimise discharges to the environment. The risk of harm from radioactivity will be ALARP.

3. Spent fuel will be disposed of at a GDF. Plans and programmes are in place to develop such a facility for legacy wastes. Waste from new nuclear power stations, whilst important, is a component of the overall development. Negative impact on local ecosystems will be controlled under relevant legislation including the Conservation (Natural Habitats, &c.) Regulations 1994. Spent fuel arising from new nuclear power stations would be expected to significantly increase the quantity of candidate waste for a GDF (depending on the number of new nuclear power stations constructed and operated). A GDF's above ground facilities might need to be larger, or in operation for a longer period, and the potential impact on habitats may increase. Local impact assessments in support of site selection and design will seek to prevent and mitigate any such identified effects.

4. The disposal of spent fuel at a GDF will require the construction of an appropriate engineered facility to minimise discharges to the environment. The risk of harm from radioactivity will be ALARP. The Government has noted that they expect that any eventual radioactivity reaching the surface of a GDF would be insignificant compared to background levels[40].

5. There is the potential for long-term positive effects on biodiversity at sites where spent fuel is stored and disposed of, as security and safety controls will reduce human access to the sites and therefore disturbance. This has been evident on existing Nuclear Licensed Sites in the UK[41].

6. Nirex[42] has previously identified the activities causing impact throughout the lifecycle of the GDF. This preliminary assessment was based on CoRWM's waste inventory[43] and did not include additional quantities of spent fuel or other radioactive wastes arising from a programme of new nuclear power stations. Nirex identified that the greatest area of disturbance may occur during construction and waste emplacement and estimated that the approximate surface site area of a disposal facility for HLW/SF or

[40] MRWS White Paper page 27
[41] Environment Agency (EA)The Environment Agency's Assessment of BNFL's 2002 Environmental Safety Cases for the Low-Level Radioactive Waste Repository at Drigg. NWAT/Drigg/05/001 (Version: 1.0) (2005).
[42]United Kingdom Nirex Limited (Nirex), Technical Notes: Summary Note for CoRWM on the Physical Disturbance for Deep Geological Disposal, Phased Deep Geological and Deep Borehole Disposal, Report No: 488235,(October 2005) page 17
[43] Committee on Radioactive Waste Management, "CoRWM's Radioactive waste and `materials inventory", July 2005, CoRWM Document Number 1279.

ILW/LLW would be:

- 1,200m x 1,200m per repository
- 1,600m x 1,200m if the repository is co-located

Summary of Potential Effects:

Timescale	C	O	D
Significance	-	+?	+?
Likelihood	M	H	M

Potential Effects

- Potential for minor negative effect during construction of the interim storage facility because of disruption of habitat.
- Potential for minor long-term positive effect from exclusion of public from areas used for interim storage of spent fuel.

Potential Mitigation and Monitoring

- Biodiversity Survey as part of BAP
- Ecological Impact Assessment

Spent Fuel: Climate Change

AoS Objective:

to minimise greenhouse gas emissions

Guide questions:

Will it take account of future effects and risks of climate change for example sea level rise?
Will future changes in weather patterns be considered?
Will it result in increased vehicular emissions (particularly carbon dioxide)?
Will the development result in an overall reduction in greenhouse gas emissions over its life time resulting from changes in:

- Transport of people and goods
- Scope, form and methods of asset construction, maintenance and demolition
- Waste recycling and disposal
- Land management practices
- Other secondary activities in the wider local and national economy

Note: Adaptation to climate change is discussed in other relevant topic appraisals, for example biodiversity, water, flood risk.

Potential Receptors:

- Human population and natural environment at all geographical scales.

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary
1. The transport of spent fuel from the site of a new nuclear power station to a GDF is likely to result in the generation of carbon dioxide. NDA has, as part of their disposability assessments under the Generic Design Assessment (GDA) process[44], which reported its findings to the "Requesting Parties"[45], has produced estimates for the lifetime spent fuel arisings for the new nuclear power station designs being assessed in the GDA process[46]. NDA has assessed the amount of spent fuel that would be produced by a single new nuclear reactor and from a 10GW new nuclear programme. A 10GW programme equates to nine AP-1000 reactors or six EPR reactors. The NDA has estimated that an AP-1000 operating for 60 years would give rise to an estimated 640 disposal canisters[47]. A fleet of nine such reactors would produce 5760 disposal canisters. In the case of the alternative EPR, the NDA has estimated that operating for 60 years each EPR would produce 900 disposal canisters. A 10GW programme comprising six EPRs would produce 5400 disposal canisters.
2. For an EPR nuclear power station it has previously been predicted that if spent fuel flasks are shipped off-site as they arose, between 4 – 6 lorry trips would be required annually[48]. For new nuclear power stations in the UK it is more likely that spent fuel will be held in interim storage on site until a GDF is ready to take it for disposal, at which point it would be transported over a comparatively short period. However even in this case, in the context of current radioactive transfers of half a million radioactive

[44] Through the GDA process the nuclear regulators are assessing the safety, security and environmental impact of power station designs, including the quantities and types of waste that are likely to arise, their suitability for storage, transport and their disposability. More information about GDA is available at the HSE's new nuclear power stations website http://www.hse.gov.uk/newreactors/index.htm

[45] The term "requesting party" is used in relation to the GDA process to identify the organisation requesting acceptance for a design through GDA. This request will normally originate from a reactor vendor, however this may also be done as a vendor/operator partnership. Consequently, the term `requesting party' is used to identify the organisation seeking the design acceptance and to distinguish it from a nuclear site licence applicant

[46] Summary Disposability Assessment for the AP-1000. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-DA-for-Wastes-and-SF-arising-from-Operation-of-APPWR-October-2009.pdf. Summary Disposability Assessment for the EPR. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-Disposability-Assessment-for-Wastes-and-Spent-Fuel-arising-from-Operation-of-the-EPWR.pdf

[47] The reference design currently being used by NDA RWMD for the purposes of estimating the costs of a geological disposal facility envisages spent fuel being encapsulated in copper canisters prior to disposal. The capacity of a copper canister is four PWR spent fuel assemblies. See page 71 of the MRWS White Paper for more on this.

[48] Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations http://www.berr.gov.uk/files/file49349.pdf Page 91

packages per year in the UK[49,50] and 255 billion freight t-km in 2007[51] the additional transport emissions would not be significant. Transport by rail would reduce CO_2 emissions compared to road transport.

3. It is assumed that spent fuel from new nuclear power stations will be transferred from interim storage on site to a GDF for disposal, and that packaging for disposal will take place either onsite or at a GDF. In the event that the spent fuel is transferred to a third location, whether for interim storage or for packaging, prior to being transported to a GDF, this has the potential for additional greenhouse gas emissions.

4. Although the effects of greenhouse gas emissions will be felt globally, the emissions during construction, operation and decommissioning will largely be determined by regional and local factors, for example local transport infrastructure and the location of the site will affect transport emissions. Impacts are not considered particularly sensitive to site location other than the distance waste may have to be transported and perhaps the mode of transport.

5. Emissions from the transport of spent fuel are not considered to have a strategically significant effect on climate change because of the relatively small amount of transport involved. The management of spent fuel will be a minor component of the nuclear power station's lifecycle. Mitigation measures can be established at each phase of the lifecycle. A GDF itself may be designed for both legacy waste and waste from new nuclear power stations and if so spent fuel from new build will affect the overall size of the facility and hence carbon burden. The overall impact will still be dominated by legacy wastes but spent fuel from new nuclear power stations will remain an important component.

Regional/ Local

1. The transport of spent fuel to a GDF will result in the generation of CO_2. Whilst largely determined by local effects these impacts will contribute to a global impact but at a scale that is not considered to be strategically significant.

[49] Health Protection Agency (HPA), Hughes JS *et al*, (2006), Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK, HPA-RPD-034, page iii
[50] The movement of spent fuel and radioactive waste is included in this total but the majority of transport packages are associated with medical radioisotopes, radiography sources, smoke detectors and other industrial uses
[51] Department for Transport (DfT), Transport Trends 2009 Edition, 2009, http://www.dft.gov.uk/pgr/statistics/datatablespublications/trends/current/

2. The transport of spent fuel may impact upon the Local Climate Change Action Plans. Consideration may be given to these during further site studies through the production of Environmental Impact Assessments (EIA).

Summary of Potential Strategic Effects:

Timescale	C	O	D
Significance	-?	+?	-?
Likelihood	L	L	L

Potential Effects

- Construction activity will produce an increase in greenhouse gas emissions, but will make only a relatively small addition to the regional inventory of emissions.
- Transportation of spent fuel will produce an increase in greenhouse gas emissions, but will only make a relatively small addition to the regional inventory of emissions.
- During operation, nuclear power stations will have a significant positive effect as they provide a low carbon source of energy. By enabling power station operation, interim storage of spent fuel will make a contribution to this effect. However, as management of spent fuel is only one aspect of power station operation, it is assessed as only having a minor positive effect.

Potential Mitigation and Monitoring

- Consider the implications of waste transports on Local Climate Change Action Plans
- Future legislation is expected under the Climate Change Act 2008, which will require any industry to demonstrate their carbon footprint from cradle to grave. "Organisations that meet the qualification criteria, which are based on how much electricity they consumed in 2008, will be obliged to participate in CRC. Participant organisations will have to monitor their emissions and purchase allowances, sold by Government, for each tonne of CO_2 they emit"[52]
- Use of rail transport for spent fuel movements
- Consideration of mitigation measures during design and construction phases of

[52] Carbon Reduction Commitment, DECC website, http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

	Interim Storage • Consideration of lifecycle analysis for spent fuel cycle including interim storage and disposal

Spent Fuel: Communities: Population, Employment and Viability

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example electricity, gas)?
Will it create significant pressure on local / regional / National Radioactive Waste Management Facilities?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Community hosting GDF
- Communities hosting new nuclear power station sites

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. No international / National / Transboundary effects anticipated.

Regional/ Local

1. Previous studies completed for the NDA on Geological disposal options for HLW and spent fuel disposal[53] concluded that it was difficult to meaningfully discuss the detailed impact of a GDF concept on a local community in the absence of a specific site. Generic statements could be made and this is also the approach adopted for this appraisal.

2. Design and construction of onsite interim storage facilities for spent fuel at new nuclear power stations will require skilled labour. This may be drawn from the local community but may also be sourced from elsewhere in the UK or from abroad. In either case the employment opportunity created should have a positive effect on the local community in the short term, both financially and socially.

3. The operation of interim storage facilities for spent fuel will generate additional employment opportunities at the new nuclear power station site. Such jobs are likely to be high quality, but a relatively small fraction of the total number required for operation of the nuclear power station.

4. Additional employment opportunities may be created in the supply chain for example relating to the manufacture of transport or disposal flasks associated with spent fuel from new nuclear power stations.

5. The Government is undertaking a GDF site selection process based on voluntarism and partnership, through the MRWS programme. The purpose of this is to ensure that there is a shared and common understanding with communities of the implications of hosting a GDF, and to develop an engagement and benefits package to ensure that community needs are addressed[54].

[53] Nuclear Decommissioning Authority (NDA), Geological Disposal Options for High Level Waste and Spent Fuel, Final Version (January 2006).
[54] Summarised from the MRWS White Paper

6. Construction of a GDF will require skilled labour. The MRWS White Paper[55] recognises significant employment opportunities may be created through the construction and operation of a GDF: "Construction and operation of a geological disposal facility will be a multi-billion pound project that will provide skilled employment for hundreds of people over many decades. It will contribute significantly to the local economy and wider socio-economic framework".

7. Further examination of the employment opportunities, and the impact on community viability and population, should be addressed once the nature and extent of onsite interim storage facilities and a GDF are developed. Application of the English Partnership Additionality Guide is recommended during specific AoS and perhaps BPEO/BPM or BAT[56] studies. An indicative number of staff for the normal operation of a power station (UK-EPR) is between 200 – 300 workers depending on the operator, rising to 1000 during outage[57]. On-site opportunities related to spent fuel management will be a small proportion of this total figure. The MRWS White Paper notes that "Construction and operation of a geological disposal facility will be a multi-billion pound project that will provide skilled employment for hundreds of people over many decades"[58]. The MRWS White Paper also notes that "it is also likely to involve major investments in local transport facilities and other infrastructure, which would remain after the facility has been closed"[59].

8. SKB[60] has previously estimated that for a GDF designed for 4,500 spent fuel canisters the following employment opportunities are created[61]:

   - 400 – 600 during the construction phase
   - 150 during initial operations
   - 220 during regular operations

9. Employment opportunities may be created during the decommissioning of interim storage facilities constructed at new nuclear power station sites.

[55] MRWS White Paper page 28
[56] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).
[57] Department of Energy and Climate Change (DECC), Cm 7386, The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association Application to Justify New Nuclear Power Stations, Volume 3, Appendix B, Annexes to the Application (December 2008)
[58] Managing MRWS White Paper page 59
[59] MRWS White Paper page 59,
[60] Svensk Kärnbränslehantering AB (SKB) Deep Repository for Spent Nuclear Fuel (2003)
[61] Note: this an estimate for Sweden. A UK GDF will be required to handle larger volumes of waste and a wider range of waste materials.

Summary of Potential Effects:	Timescale	C	O	D
	Significance	+	+	+
	Likelihood	H	H	H

Potential Effects	Potential Mitigation and Monitoring
• There is potential for minor positive effects on the economy through additional employment opportunities associated with the construction and operation of the interim spent fuel storage facilities. However, the effect of interim storage on employment will be small in relation to the effect of other aspects of construction and operation.	• Additional examination of impact on employment, viability and population during site specific studies associated with interim storage.

Spent Fuel: Communities: Supporting Infrastructure

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example electricity, gas)?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Local Communities
- Road and rail infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. National Rail Infrastructure (and to a lesser extent road transport for transfer to railheads) may be required to transport spent fuel for geological disposal. The NDA has produced estimates for the lifetime spent fuel for the new nuclear power station designs being appraised in the GDA process[62]. A 10GW programme of new nuclear power stations is estimated to produce between 5400 and 5760 disposal canisters of spent fuel over a 60 year operating lifetime depending on the reactor type(s) chosen. In the context of current transfers of around half a million radioactive packages per year in the UK[63,64] and 255 billion freight km in 2007[65] the additional pressure on the UK Transport Infrastructure would be minimal.

2. Spent fuel is expected to be stored and disposed of within the UK and hence should not impact on international or transboundary infrastructure.

Regional/ Local

1. There is the potential for negative effects on local infrastructure (e.g. schools, hospitals, housing) as a result of increases in the local workforce during construction and operation of interim storage facilities at power stations. However, the number of jobs directly related to the interim storage of spent fuel will be a relatively small fraction of the total number required for operation of the nuclear power station.

2. Transport of spent fuel for final disposal to a GDF would have an impact on local road transport and rail or road transport infrastructure in the vicinity of the storage and final disposal sites. Provided sufficient investment is made in improvements to local rail and road infrastructure during the construction of a new nuclear power station and the construction of a geological disposal facility, in both cases there could be a net benefit. In relation to a GDF, the MRWS White Paper stated that:

[62] NDA Disposability Assessments
[63] Health Protection Agency (HPA), Hughes JS *et al*, Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK, HPA-RPD-034 (2006).
[64] The movement of spent fuel and radioactive waste is included in this total but the majority of transport packages are associated with medical radioisotopes, radiography sources, smoke detectors and other industrial uses
[65] Department for Transport (DfT), Transport Trends 2009 Edition, 2009, http://www.dft.gov.uk/pgr/statistics/datatablespublications/trends/current/

"There could be spin-off industry benefits, infrastructure benefits, benefits to local educational or academic resources, and positive impacts on local service industries that support the facility and its workforce. It is also likely to involve major investment in local transport facilities and other infrastructure, which would remain after the facility had been closed" [66].

Summary of Potential Strategic Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Potential Effects

- Given the expected relatively small volumes of spent fuel generated during the operation of new nuclear power stations significant impacts on national infrastructure are considered unlikely.
- The infrastructure required to support the construction of nuclear power stations should be sufficient to support the requirement for transporting spent fuel.

Potential Mitigation and Monitoring

- GDF Site selection process
- Transport Safety Assessment
- Stakeholder Engagement

[66] MRWS White Paper, page 59

Spent Fuel: Human Health and Well-Being

AoS Objective:

to avoid adverse impacts on physical health
to avoid adverse impacts on mental health
to avoid the loss of access and recreational opportunities, their quality and user convenience

Guide questions:

Will it adversely affect the health of local communities through accidental radioactive discharges or exposure to radiation?
Will the storage of radioactive waste result in adverse physical and mental health effects for local communities?
Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?
Will it adversely affect the health of the workforce?
Will it impact upon different vulnerable communities locally?
Will it help to reduce health inequalities?
Will the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities?
Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?

Potential Receptors:

- Local, Regional, European, International populations

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Storage and disposal of spent fuel is assumed to be within the UK hence no direct effect on the health and well-being of populations outside the UK anticipated.

   The Euratom Treaty limits radiation doses to human populations of EU member states from radioactive discharges to 1mSv per year. The annual public doses received by the most exposed individual in the UK from the existing water cooled power station

at Sizewell B, where spent fuel is currently stored, are very much lower than this limit (see Regional/Local Section below). Hence it is anticipated that radiation doses received in member states will have no significant health implications.

Regional/ Local

1. The emplacement of spent fuel at an operational GDF has the potential to result in radioactive discharges which may pose a minor risk to the health and well-being of both the workforce and public in the vicinity of sites. A GDF will be designed to ensure that the risks arising from radioactive releases would be acceptable[67]:

2. During the construction of onsite spent fuel interim storage facilities there is potential for elevated noise and dust levels, which has the potential to have minor negative effects locally on the health and wellbeing of construction workers. This will be regulated under the prevailing regulatory framework and subject to site specific impact assessment where mitigation can be identified. Similar effects may arise during construction of a GDF.

3. The Sustainable Development Commission[68] concluded that the health impacts of well managed nuclear power facilities are small (particularly in comparison with other energy sources). This assessment recognises the potential issues associated with waste disposal and decommissioning.

4. The interim storage of spent fuel on-site has the potential to increase the level of radiation exposure to the workforce. The strict regulatory framework to control the level of exposure to workers and the public should reduce potential health impacts to acceptable levels and ensure that radiation doses are well within internationally agreed limits. These exposures will be ALARP and result in acceptable levels of increased stochastic effects[69,70,71]. EA regulatory requirements will ensure that BPEO/BPM or BAT[72] is applied.

[67] MRWS White Paper page 27
[68] Sustainable Development Commission, The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006).
[69] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York, (2000).
[70] Health and Safety Executive, Work with Ionising Radiation, Guidance on the Ionising Radiation Regulations 1999, L121, (2000).
[71] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[72] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).

5. Current estimates of radiation doses to the most exposed individuals in the vicinity of the existing water cooled power station at Sizewell B, where spent fuel is currently interim stored, from direct exposure and liquid and gaseous discharges are <0.005 mSv per annum[73]. Exposures at this level are much lower than those which will have any significant impact on human health[74].

6. The decommissioning of spent fuel interim storage facilities has the potential to have impacts on the health and well-being of workers. These impacts include both the risks associated with conventional demolition (e.g. injuries from falling materials and construction plant) and risks of accidental radioactive releases. The prevailing regulatory framework will apply and all doses will be ALARP.

7. Future on-site interim storage and geological disposal of spent fuel will be regulated by the EA under Environmental Permitting Regulations 2010 (EPR 10) and will require site operators to demonstrate BPM/BPEO or BAT[75] and ALARP (have been and will continue to be applied) measures are in place.

8. There will be an increased risk of radiation exposure of the workforce at a GDF from the addition of spent fuel from new nuclear power stations to the inventory of waste materials to be disposed of. These exposures will be ALARP and within regulatory requirements and result in acceptable levels of increased stochastic effects[76,77,78].

9. The MRWS White Paper said[79]:

   "The facility will be designed so that natural and man-made barriers work together to minimise the escape of radioactivity. It is inevitable that some radioactivity from the facility will eventually reach the surface. But the disposal facility will be designed to ensure that risks arising from such release would be insignificant compared to the levels of radioactivity all around us in the environment from natural background sources. The natural process of radioactive decay over time will assist this aim.".

10. The impact of the interim storage and eventual geological disposal of spent fuel from new nuclear power stations on the health

[73] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).
[74] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York, (2000).
[75] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).
[76] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York, (2000).
[77] Health and Safety Executive, Work with Ionising Radiation, Guidance on the Ionising Radiation Regulations 1999, L121, (2000).
[78] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[79] MRWS White Paper page 27

and well-being of workers and members of the public is therefore expected to be minimal. EA Technical Guidance (such as in Technical Guidance notes) will ensure that BPEO/BPM or BAT[80] is applied.

11. Whilst the physical effects on health and wellbeing of the interim storage and disposal of spent fuel is very low, there is the potential for the long term storage of spent fuel and associated large inventories of radioactive material to lead to anxiety in local communities. For example, effects on health and well-being can arise from the fear of terrorism or safety incidents. During the siting process for a GDF this will be addressed through the adoption of the voluntarism and partnership approach. The MRWS White Paper[81] states that:

"Any community that ultimately hosts a geological disposal facility will be keen to understand and agreed the nature of these benefits, and will expect the Government and the NDA to ensure that the project contributes to its development and well-being".

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Potential Effects

- Construction and decommissioning of interim storage facilities may produce negative impacts due to the risks of accident and injury to the workforce. However, because these potential effects are localised they are not considered to be strategically significant.
- Neither are the potential positive effects of employment on health and well-being considered of strategic significance because of the relatively small proportion of the power station's workforce that would be engaged on construction and operation of the interim storage facility.

Potential Mitigation and Monitoring

- Mitigation of effects during construction and decommissioning by adoption of suitable techniques including: risk assessment, production of health and safety plans and compliance with CDM requirements
- Radioactive Discharge and Environmental Monitoring required by

[80] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT)
[81] MRWS White Paper page 59

• On site interim storage of spent fuel could result in managed radioactive discharges. However, provided these are within authorised limits there should not be any negative effective on the physical well-being of either the workforce or the public in the vicinity of these sites. • Therefore, the effects overall are considered to be neutral.	Site Specific Authorisations under RSA93 and reported in CEFAS[82] and Pollution Inventory. • Improved abatement technologies current guidance in Environment Agency TGN M11[83] and M12[84]

[82] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).
[83] Environment Agency, Technical Guidance Note M12 http://www.environment-agency.gov.uk/static/documents/5-PMHO1299BKHG-e-e.pdf
[84] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

Spent Fuel: Landscape and Cultural Heritage

AoS Objective:

to avoid adverse impacts on the internationally and nationally important features of the historic environment
to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
to avoid adverse impacts on nationally important landscapes
to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness

Guide questions:

Will it adversely affect landscapes within or immediately adjacent to a National Park?
Will it adversely affect landscapes in or immediately adjacent to an AONB or NSA?
Will it adversely affect Heritage Coast or Preferred Conservation Zones?
Will it adversely affect local landscapes/townscapes of value?
Will it affect the levels of tranquillity in an area?
Will it adversely affect the landscape character or distinctiveness?
Will it result in increased levels of light pollution?
Will it adversely affect historic sites of international/national importance and their setting?
Will it adversely affect other historic sites of known value?
Will it adversely affect landscapes of historic importance?

Potential Receptors:

- Built heritage, archaeology and historic landscapes of local to international importance

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. The potential sites for new nuclear power stations include locations where effects on landscape or cultural heritage designations of national importance cannot be ruled out. However, the additional impact from constructing and operating facilities for managing spent fuel at nuclear power station sites is likely to produce only minor additional effects as interim storage of spent fuel will take place within the footprint of the nominated site.

Regional/ Local

1. There is recognition that the siting of many new nuclear power stations is likely to make some use of existing nuclear sites, thereby largely limiting landscape and visual impacts to areas affected by existing power stations. The onsite management and interim storage of spent fuel may require a number of new facilities to be commissioned. Such facilities will be subject to the prevailing planning requirements and hence developments will be supported by appropriate assessments. All plans, whether on existing or new nuclear licensed sites, will need to prepare specific visual and landscape management plans.

2. The visual impact of spent fuel interim storage facilities will be small in comparison with the overall effect of the nuclear power plant on the landscape. The Nuclear Industry Association has estimated that the footprint of an EPR is approximately 250,000m^2. The reactor building is approximately 60m high and the stack extends a few meters above this. It is expected that the actual height of this will be determined by a site specific assessment. The AP1000 plant typically consists of a fenced area of approximately 10 ha (100,000 m^2). Building heights range from 100m for the containment and 44m for the turbine hall to 11m elevation for the radioactive waste store[85]. Total land use is estimated to be in the range of 50 – 70 hectares. A spent fuel store will be a small proportion of the overall facility and will therefore have a minor negative effect on landscape.

3. It is expected that a GDF will require a variety of surface facilities, including administration, support buildings, and possibly a waste encapsulation plant and visitor centre[86]. Therefore there is the potential for a minor negative effect on the landscape if new build waste were to be accommodated in the same facility as legacy waste and this were to increase the size of the above

[85] The Justification of Practices involving ionising Radiation Regulations 2004 Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations volume 3, appendix B: Annexes to the application (December 2008), http://www.berr.gov.uk/files/file49349.pdf page 68
[86] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.defra.gov.uk/environment/radioactivity/mrws/pdf/white-paper-final.pdf page 71

ground facility at a GDF.

4. Much of the impact of adding spent fuel from new nuclear power stations to the inventory of waste to be disposed of in a GDF will be on the underground "footprint" of the facility. However the facility may have to stay open longer, and it is possible that there might be some additional surface infrastructure. Therefore the disposal of spent fuel from new nuclear power stations in a GDF might have a negative effect on the landscape. The significance of this effect would depend on the site chosen for the GDF.

5. The MRWS White Paper[87] states that once a GDF has been filled with waste the shaft and tunnels can be backfilled and sealed and the surface facility decommissioned. The site will be monitored under the prevailing regulatory framework. The site itself may then be reused.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	-?	-?
Likelihood	M	M	L

Potential Effects

- There is the potential for minor negative effects on landscape during the construction and operation of both on site interim storage facilities and a GDF. Once locations and designs are finalised the potential effects of both of these facilities on landscape can be more meaningfully appraised.

Potential Mitigation and Monitoring

- Completion of appropriate environmental impact studies in support of additional disposal facility planning applications
- Completion of appropriate environmental impact studies in support of spent fuel interim storage facilities at nuclear power stations sites

[87] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.defra.gov.uk/environment/radioactivity/mrws/pdf/white-paper-final.pdf page 72

	• Effects may be minimised if location chosen was formerly industrial land or previously housed nuclear facilities • Landscaping requirement imposed on site by planning requirements • Design to meet local environmental requirements

Spent Fuel: Soils, Geology and Land Use

AoS Objective:

to avoid damage to geological resources
to avoid the use of greenfield land and encourage the re-use of brownfield sites
to avoid the contamination of soils and adverse impacts on soil functions

Guide questions:

Will it result in the compaction and erosion of soils?
Will it lead to the removal or alteration of soil structure and function?
Will it lead to the contamination of soils which would affect biodiversity and human health?
Will it compromise the future extraction/ use of geological/ mineral reserves?
Will it result in the loss of agricultural land?
Will it lead to damage to geological SSSIs and other geological sites?
Will it result in the loss of Greenfield land?
Will it adversely affect land under land management agreements?

Potential Receptors:

- Areas in the vicinity of new power stations designated of geological significance.
- Areas in the vicinity of new power stations where land use could be affected, e.g. agricultural land
- Workforce and local populations in the vicinity of new power stations.
- Ecosystems, in particular designated sites of conservation importance in the vicinity of new power stations.

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

Not significant.

Regional/ Local

1. New nuclear power stations will generate additional spent fuel. Spent fuel will be included in the total waste inventory for geological disposal and this will impact on the overall size of a GDF. As well as the requirement to accommodate additional disposal containers the heat generated from the containers of spent fuel from new nuclear power stations may necessitate additional space requirements underground. Studies supporting the development of a GDF will be required to consider such impacts. The NDA confirm this requirement in their Management of Waste from New Nuclear Power Stations position paper and note that this will be strongly influenced by the heat output of the waste at the time of disposal, in turn influenced by, among other things, the length of time spent in interim storage[88].

2. The development of interim storage facilities at new nuclear power station sites will require additional land use within the nuclear site licence boundary. The exact requirements for land use will be dependent upon the nature and extent of the facilities chosen by the developer. Site specific EIAs are more appropriate means of assessing the specific impact of such developments. Where development of interim storage facilities is considered on brownfield sites (which may include contaminated land) additional waste issues may arise as well as the disturbance and creation of pathways for potential contamination.

3. It is anticipated that new nuclear power station sites will include interim storage facilities for spent fuel[89]. A Best Practicable Environmental Option Study (BPEO) completed by British Energy at Sizewell B identified traditional wet storage, dry storage in casks and dry storage in vaults[90]. The development of such facilities at new nuclear power station sites will be subject to the prevailing regulatory framework, including planning arrangements, and may be designed and developed within the context of the wider facility. Interim storage facilities will have a minor impact on soils, geology and land use, but this will be small in the context of the development of the new nuclear power station as a whole. Assessment is more usefully completed in the context

[88] Nuclear Decommissioning Authority (NDA), Waste and Nuclear Materials Department Position Paper, Introduction to Low Level Waste Issues, Issue 1, W&NM/PP/004, 14/03/09, (2009d).
[89] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.defra.gov.uk/environment/radioactivity/mrws/pdf/white-paper-final.pdf
[90] British Energy, Managing spent fuel at Sizewell B, Finding the Right Interim Storage beyond 2005, http://www.british-energy.com/documents/Spent_Fuel_brochure.pdf, accessed 28/04/09, (2005).

of the local environment and therefore targeted EIAs are considered more appropriate to assess the impact.

4. The construction of onsite interim storage facilities for spent fuel from new nuclear power stations is likely to have a minor negative impact on geology and soils due to removal or alteration of soil structure and possible loss of agricultural or greenfield land. Whether such effects arise will depend on the siting and design of interim storage facilities and the local conditions at the site.

5. Similar types of effects will potentially be produced by construction of a GDF that may comprise surface structures, access to underground tunnels and disposal vaults[91]. The spatial extent and duration of any impacts are likely to be greater at a GDF than for interim storage facilities. The impact of a GDF on geology and land use will be considered during site specific assessments and the contribution of spent fuel from new nuclear power station sites will be taken into account in these assessments.

6. The construction and operation of a single co-located GDF would have smaller environmental impacts than the construction and operation of more than one GDF. The MRWS White Paper notes that it would be possible to build more than one GDF, for example one for ILW/LLW and one for HLW/spent fuel, but the UK Government sees no case for having separate facilities if one facility can be developed to provide suitable, safe containment for the Baseline Inventory[92]. With regard to new build wastes, the Government considers that it is technically possible and desirable to dispose of new waste in the same GDF as legacy wastes and has committed to explore this further through the MRWS process[93].

7. Where a GDF is developed for co-located wastes, then depending upon the requirement for spent fuel storage the size of such a facility will largely be determined by the current inventory associated with legacy ILW. The NDA has evaluated the disposability of waste from the new nuclear power stations. As part of their disposability assessments under the Generic Design Assessment (GDA) process[94], which reported its findings to the "Requesting Parties"[95], the NDA has produced estimates for the

[91] MRWS White Paper Annex A
[92] MRWS White Paper page 29
[93] Nuclear White Paper page 99
[94] Through the GDA process the nuclear regulators are assessing the safety, security and environmental impact of power station designs, including the quantities and types of waste that are likely to arise, their suitability for storage, transport and their disposability. More information about GDA is available at the HSE's new nuclear power stations website http://www.hse.gov.uk/newreactors/index.htm
[95] The term "requesting party" is used in relation to the GDA process to identify the organisation requesting acceptance for a design through GDA. This request will normally originate from a reactor vendor, however this may also be done as a vendor/operator partnership. Consequently, the term `requesting party' is used to identify the organisation seeking the design acceptance and to distinguish it from a nuclear site licence applicant

lifetime spent fuel for the new nuclear power station designs being assessed in the GDA process[96]. The NDA has considered the potential impact on the size of a GDF of the disposal of spent fuel from a single new nuclear reactor and from a 10GW new nuclear programme. 10GW equates to nine AP-1000 reactors or six EPR reactors.

8. The NDA has estimated that an AP-1000 operating for 60 years would give rise to an estimated 640 disposal canisters[97], requiring an area of approximately 0.11km2 for the associated disposal tunnels. A fleet of nine such reactors would require an area of approximately 1km2, excluding associated service facilities. This represents approximately 6% of the area required for legacy HLW and spent fuel per reactor, and approximately 55% for the illustrative fleet of nine AP-1000 reactors.

9. NDA has estimated that an EPR operating for 60 years would give rise to an estimated 900 disposal canisters, requiring an area of approximately 0.15km2 for the associated disposal tunnels. A fleet of six such reactors would require an area of approximately 0.9km2, excluding associated service facilities. This represents approximately 8% of the area required for legacy HLW and spent fuel per reactor, and approximately 50% for the illustrative fleet of six EPR reactors.

10. The MRWS White Paper[98] estimates that with regard to the legacy inventory, the footprint (underground area of host rock) for an ILW / LLW disposal facility would be in the order of 1km2 and for spent fuel/HLW would be of the order of 3km2. The MRWS White Paper also acknowledges that in practice it may be possible to build a geological disposal facility over a smaller area, by building deposition tunnels or vaults on different levels. This would however depend on the geology of the site.

11. The NDA has started exploring the engineering possibilities for a geological disposal facility. The NDA[99] has evaluated a range of geological concepts for a GDF and stated that it is not appropriate at this stage of the siting programme to select a preferred option. Development of a GDF will continue and it is during this process that the overall impact on soils, geology and land use can be fully evaluated.

[96] Summary Disposability Assessment for the AP-1000. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-DA-for-Wastes-and-SF-arising-from-Operation-of-APPWR-October-2009.pdf. Summary Disposability Assessment for the EPR. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-Disposability-Assessment-for-Wastes-and-Spent-Fuel-arising-from-Operation-of-the-EPWR.pdf

[97] The reference design currently being used by NDA RWMD for the purposes of estimating the costs of a geological disposal facility envisages spent fuel being encapsulated in copper canisters prior to disposal. The capacity of a copper canister is four PWR spent fuel assemblies. See page 71 of the MRWS White Paper for more on this.

[98] MRWS White Paper page 72

[99] Baldwin, B., Chapman, N. and Neall, F., Report for the UK Nuclear Decommissioning Authority, Geological Disposal options for High-Level Waste and Spent Fuel, Version: Final, (January 2008).

12. The closure of a GDF and decommissioning of interim storage facilities will impact soils, geology and land use. The impacts of decommissioning interim storage facilities are likely to be positive as it may be possible to return soils geology and land use to conditions similar to those before construction, although the objectives for decommissioning are not yet clearly established.

Summary of Potential Strategic Effects:

Timescale	C	O	D
Significance	-?	-?	-?
Likelihood	H	H	-

Potential Effects

- New interim storage facilities will be required at new nuclear power station sites. The impact on soils, land use and geology will be dependent on the interim storage option chosen and on local conditions at the site but it is possible that minor negative effects on soil structure and geology may arise within the footprint of the store.
- Contamination of soil adjacent to the interim store should not arise provided that the facility is constructed and operated in accordance with best practice.

Potential Mitigation and Monitoring

- Site specific EIA or other studies to support development of interim storage facilities
- Continued monitoring of the facility during construction and operation to identify potential changes to soils and geology as a result of the development

Spent Fuel: Water Quality and Resources

AoS Objective:

to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology)
to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives
to avoid adverse impacts on the supply of water resources
to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives

Guide questions:

Will it result in the increased sedimentation of watercourses?
Will it adversely affect channel geomorphology?
Will hydrology and flow regimes be adversely affected by water abstraction?
Can the higher defence standards be achieved without compromising habitat quality and sediment transport?
Will it result in the sediment loading of watercourses?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it affect designated Shellfish Waters?
Will it affect Freshwater Fish Directive sites?
Will it increase turbidity in watercourse?
Will it increase the temperature of watercourses?
Will it adversely affect water supply as a result of abstraction?
Will it significantly increase demand for water?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local water resources both surface water and groundwater relevant to interim storage and final disposal sites
- National and International coastal environment identified in site specific reports
- Sensitive marine and freshwater habitats, identified in site specific reports

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Flooding of any facility located close to the coast is a possibility with sea level rises predicted as a result of climate change. Although the spent fuel will be securely contained when placed in interim storage, flooding of this facility would hamper operations and could lead to deterioration in the condition of the packages if dry storage in casks/canisters is used. Therefore, mitigating measures to prevent flooding of interim stores containing spent fuel may need to be provided for the whole of their expected lifetime, which may extend for about 100 years after the end of power station operation. This provision would avoid the risk of contamination of the marine environment that could otherwise lead to national or transboundary effects.

Regional/ Local

1. Spent fuel will not be present during construction; therefore a direct impact is not anticipated.

2. As noted under International/National/Transboundary effects, flooding of spent fuel storage facilities at power stations could potentially lead to a small risk of contamination of local surface water and/or groundwater. It is currently Government policy for any new development to submit a FRA alongside any planning application as stated in paragraphs 10-13 of Planning Policy Statement 25. This process ensures that all aspects of flood risk are assessed prior to construction. A FRA takes into account the facilities size, design, building use and construction material, as well as all aspects of drainage, local coastal and fluvial systems and investigates any alternative mitigation options. The FRA would be encompassed within the overall assessment for the nuclear power station and this would provide intervention for spent fuel interim storage facilities.

3. There is a potential impact to the environment arising from accidental releases of radioactivity during the transportation of spent fuel flasks to and from sites. The potential of a release occurring is minor as spent fuel flask, type B(u) and B(m) containers, are specifically designed and tested to ensure no release would occur in the most extreme of situations, as demonstrated through destructive testing experiments.

4. Under the Nuclear Installations Act 1965 a safety case will be required for the operation of an interim storage facility. As part of this an investigation into the release of radionuclides into the environment will be undertaken. This will account for affects to the local marine and freshwater environment as a flooding event is a foreseeable accident. Monitoring of these environments will include turbidity tests and water flow may also be performed as part of the RSA 1993 authorisation held by the site.

5. There is a potential that waste emplaced in a GDF could interact with the local groundwater systems due to the large timescales involved. Groundwater contact with disposed spent fuel canisters could potentially damage the integrity of the engineered canisters and also provide a pathway for contaminates to be released into the environment. Facilities in Europe have completed comprehensive research and development examining geological disposal and specifically the characteristics of groundwater at their specified sites prior to spent fuel disposal. The UK would follow similar methods in investigating the suitability and final siting of a disposal facility [100]

6. As part of the licensing process for a GDF, investigations into the release of radionuclides into the environment will be undertaken. This will take into account effects to the local groundwater and freshwater environment as a flooding event is foreseeable. Monitoring of these environments including water flow and effects to the local environment should also be performed as part of the RSA 1993 authorisation held by the site.

Summary of Potential Strategic Effects:	Timescale	C	O	D
	Significance	-?	-?	-?
	Likelihood	L	L	M

Potential Effects	**Potential Mitigation and Monitoring**

[100] MRWS White Paper page 27

• Potential contamination of surface and groundwater from non-radioactive run-off during construction of interim storage for spent fuel. • Potential damage to interim storage facility in the event of flooding, leading to deterioration in condition of storage canisters and possible risk of contamination of surface or ground waters.	• Construction design/location for new facilities taking account of FRA will minimise the potential possibility of flooding of a site and their effects should flooding occur. • Advances in designs to include monitoring and abatement techniques preventing the release of contamination into the environment (Environment Agency TGN M12 [101]) • Monitoring of the local environment is a requirement under Environmental Permitting Regulations 2010 for large Nuclear Licensed sites. Any effect to the local environment is therefore monitored and recorded

[101] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

Flood Risk

AoS Objective:

14. To avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible

Guide questions:

Will it result in demand for higher defence standards?

Potential Receptors:

- Site workers
- Local/ District ecosystems in coastal waters

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

Regional/ Local

1. The onsite interim storage of spent fuel will be provided within the footprint of the nuclear power station site. The site level appraisals have highlighted the need to undertake site-specific investigations, including flood risk assessment, to determine the most appropriate and sustainable methods for protecting sites from flooding. The measures taken to protect nuclear power stations from flooding will also serve to protect the spent fuel interim storage facilities. However, the possibility that onsite interim storage of spent fuel might be required for up to 100 years after the end of power station operation might extend the period for which flood protection of the site will need to be maintained.
2. To mitigate against potential negative effects on coastal processes, if flood protection measures are required they must be designed, constructed and managed so as to minimise any negative impacts.
3. An increase of impermeable surfaces as a result of a new power station could increase surface water runoff, which has the potential to increase the risk of flooding to the surrounding area. However, the interim storage facility will occupy only a small part of the site and so its contribution to this aspect of flood risk will not be great. A Flood Risk Assessment (FRA) would

identify any potential problems with increased surface run-off caused by the introduction of a new facility and mitigation techniques may be required to be identified before planning permission is granted

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	0	0	-
Likelihood	H	H	H

Significant Effects

- Provided that interim storage facilties for spent fuel are within the footprint of the site, the effect of spent fuel storage on flood risk during construction and operation should not alter the measures required to protect other facilities on the site.
- Interim storage is likely to be the factor that determines the overall lifetime of the site and could potentially be required for a period of about 100 years after the end of power generation. In the event that onsite interim storage of spent fuel is required for this length of time and that flood protection needs to be maintained for this period, there could be a significant negative effect on flood risk.

Mitigation and Monitoring Possibilities

- It may be possible to mitigate these effects through appropriate design, construction and management of flood protection measures.

Section 4 Appraisal Matrices: Intermediate Level Waste (ILW)

Notes on Appraisal approach

5. The discussion of potential effects and mitigation possibilities includes: the effects of waste management at nuclear power station sites, transport offsite; and effects at the site for final disposal of the waste where applicable.
6. The summary of potential effects for each topic includes the effects of waste management at nuclear power station sites and transport offsite only.
7. The summary of potential effects is carried to the summary tables for each waste type that are presented in Section 6 of the Main AoS.

Key to Appraisal				
Key to appraisal of Strategic Effects:			**Abbreviations:**	
Significance		**Category of effect**	**Timescale**	
++	Major Significant	Development actively encouraged as it would resolve an existing sustainability problem. Effect considered to be of national/ international significance.	C	Construction stage
+	Minor Significant	No Sustainability constraints and development acceptable. Effect considered to be of national/ international significance.	O	Operation stage
0	No significance	Neutral effect	D	Decommissioning stage
-	Minor Significant	Potential sustainability issues; mitigation and / or negotiation possible. Effect considered to be of national/ international significance.	**Likelihood**	
--	Major Significant	Development problematical because of known sustainability issues; mitigation or negotiation difficult and/ or expensive. Effect considered to be of national/ international significance.	H	High Likelihood
?	Uncertainty	Where the significance of an effect is particularly uncertain, for example because insufficient information is available at the plan stage to fully appraise the effects of the development or the potential for successful mitigation, the significance category is qualified by the addition of '?'.	M	Medium Likelihood
			L	Low Likelihood

ILW: Air Quality

AoS Objective:

To avoid adverse impacts on air quality

Guide questions:

Will it result in the release of radionuclides that may adversely affect human health or biodiversity?
Will it contribute to an increase in the number or expansion of Air Quality Management Areas (AQMAs)?

Potential Receptors:

- Local populations (at the power station site and at a Geological Disposal Facility (GDF))
- Regional and National Populations (transport)
- Sensitive habitats identified in site specific reports (at the power station site and at a GDF)

Potential Effects and Mitigation Possibilities:

International / National / Transboundary

1. Intermediate Level Waste (ILW) from new nuclear stations is expected to be subject to interim storage at a new nuclear site and subsequently disposed of at a UK-located GDF. Transport overseas is not anticipated. An impact on air quality from ILW is not anticipated.

2. All relevant Euratom Treaty[102] requirements are transposed into UK law. Article 37[103] of this treaty requires each member state to provide the commission with information relating to any plan for the disposal of radioactive waste to enable each member state to

[102] European Union European Atomic Energy Community (EURATOM treaty), (1957). http://www.europarl.europa.eu/parliament/archive/staticDisplay.do?id=77&pageRank=11&language=EN
[103] If an EU Member State alters the way in which it plans to dispose of radioactive waste, seeks to reduce restrictions on discharges, or has a new facility which may increase emissions it must make a submission to the Commission seeking an opinion on the proposals.

determine if this will result in radioactive contamination of their environment (water, soil or airspace). The development of new nuclear power station site interim storage facilities for ILW and for a GDF will require an Article 37 submission.

Regional/ Local

1. The potential for direct impacts on air quality associated with ILW is related to radioactive emissions (waste gases, mists and particles). The potential for indirect impacts are associated with ancillary processes such as emissions from the transport of wastes.

2. The generation of ILW in addition to legacy wastes through the operation of new build reactor stations will increase the quantity of waste to be disposed of in a GDF. The total quantity of ILW produced by a new nuclear programme will depend on the size of the programme, but is expected to be small in comparison with the volumes of legacy ILW. The 2007 consultation on the Future of Nuclear Power contained estimates by Nirex that a new build programme equivalent to 10 AP-1000s would increase the quantity of ILW by around 3%[104].

3. More recent work by NDA means it is now possible to update this estimate. The NDA, as part of their disposability assessments under the Generic Design Assessment (GDA) process, which reported its findings to the "Requesting Parties", has produced estimates for the lifetime ILW arisings for the new nuclear power station designs being assessed in the GDA process[105].

4. NDA has considered the potential impact on the size of a GDF of the disposal of ILW from a single new nuclear reactor and from a 10GW new nuclear programme. 10GW equates to nine AP-1000 reactors or six EPR reactors. The volume of ILW for disposal is subject to some variation depending on assumptions regarding packaging and conditioning technologies that might be adopted by future operators, but the NDA has concluded that in all cases the necessary increase in the "footprint area" is small. For the AP-1000 the necessary increase in the GDF "footprint area" corresponds to approximately 65m of disposal vault length per reactor.. This represents approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of six AP-1000 reactors. The findings are similar for the EPR, where the NDA has calculated that each EPR would require an additional 60m of disposal vault length, representing approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of six EPR reactors.

[104] The Future of Nuclear Power page 135.
[105] Summary Disposability Assessment for the AP-1000. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-DA-for-Wastes-and-SF-arising-from-Operation-of-APPWR-October-2009.pdf. Summary Disposability Assessment for the EPR. http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-Disposability-Assessment-for-Wastes-and-Spent-Fuel-arising-from-Operation-of-the-EPWR.pdf

5. The UK has an established regulatory regime supported by independent regulatory bodies; the Nuclear Installations Inspectorate (NII) and Environment Agency (EA). All facilities, including interim storage arrangements at reactor sites and at a GDF itself will be subject to comprehensive regulation by the NII and impacts on air quality subject to appropriate preventative and mitigation measures. A GDF concept will be designed to ensure that discharges will be subject to authorisation by the EA and fall within constraints and limits.

6. The Managing Radioactive Waste Safely (MRWS) White Paper stated that "the facility will be designed so that natural and man-made barriers work together to minimise the escape of radioactivity. It is inevitable that some radioactivity from the facility will eventually reach the surface. But the disposal facility will be designed to ensure that risks arising from such release would be insignificant compared to the levels of radioactivity all around us in the environment from natural background sources. The natural process of radioactive decay over time will assist this aim."[106] There is therefore the potential for minor negative effects on air quality but ALARP[107] will apply.

7. Radioactive emissions from operational sites are authorised by the Environment Agency (EA) under the Environmental Permitting Regulations 2010 (EPR 10). Emissions are required to be ALARA[108] and monitored and managed in accordance with documented arrangements approved by the EA. An Article 37 submission' a requirement of the Euratom Treaty' which seeks to understand the impact of radioactive emissions on EU member states, will be required for both a GDF and for new nuclear power station sites, in which interim storage facilities will be part of a wider submission.

8. The application of various treatment technologies of ILW may impact upon air quality (for example, thermal destruction of ion exchange resins). A RSA authorisation requires the site operator to apply Best Practical Environmental Optional (BPEO), Best Practicable Means (BPM) or Best Available Technique (BAT)[109] to minimise waste arisings and apply the waste management hierarchy[110]. Implementation of these techniques to new nuclear power stations will seek to minimise ILW, including emissions to

[106] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://mrws.decc.gov.uk/ page 27
[107] As Low as Reasonably Practicable (ALARP). To satisfy this principle, measures necessary to reduce risk must be taken until the cost of these measures whether in money, time or trouble, is disproportionate to the reduction of risk..
[108] As Low As Reasonably Achievable (ALARA). The ALARA principle is contained in the Euratom Basic Safety Standards Directive 96.29, which is transposed into UK Law. Essentially, it means that all reasonable steps should be taken to protect people. In making judgement, factors such as the costs involved in taking protection measures are weighted against benefits obtained, including the reduction in risks to people.
[109] The EA is proposing to replace BPEO / BPM in England and Wales with Best Available Techniques (BAT).
[110] A hierarchical approach to minimise the amount of waste requiring disposal. The hierarchy consists of non-creation where practicable, minimisation of arisings where the creation of waste is unavoidable, recycling and reuse, and only then disposal.

air. The reactor designers indicate that these modern designs generate less higher activity waste [111]. It is expected that operators of new nuclear power stations will be responsible for establishing their own interim storage arrangements.

9. ILW will not be present during construction, hence no impact is expected.

10. The MRWS White Paper[112] describes a number of engineered barriers to prevent radioactive emissions to the outside environment during interim storage of waste packages. Such barriers would include the waste form itself as the primary barrier, the waste container as the secondary barrier, control of the store environment is the tertiary barrier and the store structure itself is the final layer of protection. Together these barriers would minimise the impact on air quality.

11. This approach would apply to the development of facilities for ILW. The UK has designed standardised disposal containers for ILW.

12. There is evidence internationally of the safe disposal of ILW. For example Sweden has operated an ILW geological disposal facility at Forsmark since 1988. Approximately 9400m^3 of low activity ILW had been interred by the end of 2006[113]. This facility has performed well with no radioactivity released[114].

13. There will be transport emissions associated with the movement of ILW to a GDF. The potential impact of such emissions are expected to be minor when considered in terms of national transport emissions and could be partially mitigated by the adoption of rail for the movement of ILW. The development of a GDF and a new nuclear power station site's interim storage facility would be expected to consider the transportation options. Air pollution can be minimised and controlled through working in accordance with good site environmental practices and management through the use of Construction Environmental Management Plans.

14. The carriage of radioactive materials, including ILW is governed by International agreements and implemented through UK regulations. The applicable UK legislation is the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment

[111] Health & Safety Executive, Reactor Designs, www.hse.gov.uk/reactors/reactordesigns.htm, accessed 16/03/2009
[112] MRWS White Paper page 24
[113] Almkvist, L. & Gordon, A. SKB Report R-07-17, Low and Intermediate Level Waste in SFR-1, Reference Waste Inventory (2007).
[114] Svensk Kärnbränslehantering AB, SFR Final repository for short-lived radioactive waste Accessed 06/05/09 (February 2006), http://www.skb.se/upload/publications/pdf/Engelsk_low_res.pdf page 6

Regulations 2009 that replaced the earlier 2007 version. The UK regulations transpose Commission Directives 2006/89/EC[115] and 2006/90/EC[116] into UK law. It is assumed that ILW will be transported to a GDF in a shielded transport flask designed to minimise external dose and provide containment of radioactivity compliant with regulatory requirements.

15. There is potential for the decommissioning of interim storage facilities for ILW to have negative effects on air quality. Demolition of structures has the potential to generate contaminated dusts etc. New facilities design will consider the decommissioning of interim storage facilities at the design stage to ensure waste arisings are minimised. BPEO/BPM or BAT[117] studies supporting decommissioning activities will ensure waste arisings including emissions to air are minimised.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	0	-?
Likelihood	H	H	H

Potential Effects

- Potential for minor negative effects on local air quality associated with construction and decommissioning of interim storage facilities for ILW, associated with non-radioactive emissions from construction plant and vehicles.
- Transport associated with the movement of ILW to disposal facilities has the potential for minor negative effects on air quality.
- Radioactive emissions associated with operational interim storage facilities will have a negligible effect and will be managed by engineered containment and compliance with regulations.

Potential Mitigation and Monitoring

- New nuclear power station site specific impact assessments
- Engineered barriers in interim storage facilities
- Statutory monitoring associated with authorisations established at operational facilities
- Annual pollution inventory at new nuclear power station sites
- Use of rail transport to minimise emissions

[115] Council Directive 2006/89/EC amends Council Directive 94/55/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by road (known as ADR).
[116] Council Directive 2006/90/EC amends Council Directive 96/49/EC that incorporates the international agreements based on the UN Transport of Dangerous Goods Model Regulations for carriage of goods by rail (known as RID).
[117] The EA is proposing to replace BPEO / BPM with Best Available Technique (BAT)

ILW: Biodiversity

AoS Objective:

to avoid adverse impacts on the integrity of wildlife sites of international and national importance
to avoid adverse impacts on valuable ecological networks and ecosystem functionality
to avoid adverse impacts on Priority Habitats and Species including European Protected Species

Guide questions:

Will it result in the loss of habitats of international/national importance?
Will it affect other statutory or non-statutory wildlife sites?
Will it result in harm to internationally or nationally important or protected species?
Will it adversely affect the achievement of favourable conservation status for internationally and nationally important wildlife sites?
Will it affect the structure and function/ecosystem processes that are essential to restoring, securing and/or maintaining favourable condition of a feature or a site?
Will the proposal enable the BAP targets for maintenance, restoration and expansion to be met?
Will the proposal result in changes to coastal evolution that is otherwise needed to sustain coastal habitats?
Will it result in the release of harmful substances for example. oil, fuel and other pollution into water bodies which could affect aquatic ecosystems?
Will it result in the accidental migration of radionuclides which could harm aquatic or terrestrial ecosystems?
Will it result in changes to stream hydrology and morphology that could affect aquatic or terrestrial ecosystems?
Will it result in thermal discharges that could adversely affect aquatic ecosystems?
Will it result in soil contamination that could damage aquatic or terrestrial ecosystems?

Potential Receptors:

- Local, Regional, European and International environment

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 5. The European Directive (92/43/EEC) on the Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive) protects habitats and species of European nature conservation importance by establishing a network of internationally important sites designated for their ecological status. These are referred to as Natura 2000 sites or European Sites, and comprise of Special Protection Areas[118] (SPAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and European Offshore Marine Sites (EOMS) designated under the EC Habitats Directive. Potential SPAs (pSPAs) and Ramsar sites are included in the assessment in line with Government policy. The draft Nuclear NPS has been assessed in accordance with the European Habitats Directive. The findings have been incorporated into the AoS Report and the details of the Habitats Regulations Assessment (HRA) are reported separately. 6. Work is ongoing within the EU on methodologies to assess the impact of ionising radiation on biota. They include: • ERICA[119] (Environmental Risk from Ionising Contaminants: Assessment and Management) will provide an integrated approach to scientific, managerial and societal issues concerned with the environmental effects of contaminants emitting ionising radiation, with emphasis on biota and ecosystems. • FASSET[120](Framework for assessment of environmental impact of ionising radiation in major European ecosystems) includes: source characterisation; description of seven major European ecosystems; selection of a number of reference organisms on the basis of prior ecosystem and exposure analysis; environmental transfer analysis; dosimetric considerations and effects analysis; • PROTECT[121](Protection of the Environment from Ionising Radiation in a Regulatory Context) will evaluate the practicability and relative merits of different approaches to protection of the environment from ionising radiation and compare these with methods used for non-radioactive contaminants. By understanding the full environmental impacts of ionising radiation on the environment an improved impact assessment can

[118] Classified under the EC Birds Directive 1979.
[119] http://www.ceh.ac.uk/protect/ERICAdeliverables.html
[120] http://www.ceh.ac.uk/protect/FASSETdeliverables.html
[121] http://www.ceh.ac.uk/protect/EPICdeliverables.html

be developed. It is expected that these methodologies will be used to give a more accurate estimate of the impact of new build power stations than previously possible for existing nuclear facilities

7. Article 37 of the Euratom Treaty[122] requires each member state to provide, for any plans for disposal of radioactive waste, details of the potential for radioactive contamination of water, soil or air space of another member state. Article 13 of the Basic Safety Standards Directive[123] issued under Euratom limits the effects of such contamination by imposing a limit on public dose of 1mSv. These measures will also tend to limit radiation doses to flora and fauna (except in areas of extremely low human population density).

8. It is assumed that ILW will be stored and disposed of in the UK; therefore no direct effects on habitats outside the UK are anticipated. As previously mentioned, the draft Nuclear NPS has been assessed in accordance with the European Habitats Directive. The findings have been incorporated into the AoS Report and the details of the Habitats Regulations Assessment (HRA) are reported separately.

Regional/ Local

7. Radioactive discharges resulting from interim storage of ILW on the site of a new nuclear power station and geological disposal of ILW in a GDF will be controlled by authorisations issued by the EA under the Environmental Permitting Regulations 2010. This ensures that doses from all sources to members of the public are less than 1mSv per annum. This will also tend to limit radiation doses to flora and fauna (except in areas of extremely low human population density). As the annual public doses received from the existing water cooled power station at Sizewell B, where ILW is currently in interim storage, are <0.005 mSv[124] it is unlikely that there will be any measurable effects on biodiversity as a result of radioactive discharges from new build Pressurised Water Reactors.

8. The interim storage of ILW at new nuclear power station sites will require the construction of an appropriate engineered facility to minimise discharges to the environment. The risk of harm from radioactivity will be ALARP.

9. ILW will be disposed of at a GDF. Plans and programmes are in place to develop such a facility for legacy wastes. Waste from

[122] European Union European Atomic Energy Community (EURATOM treaty), (1957).
[123] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[124] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).

new nuclear power stations, whilst important, is a component of the overall development. Negative impact on local ecosystems will be controlled under relevant legislation including the Conservation (Natural Habitats, &c.) Regulations 1994. ILW arising from new nuclear power stations would be expected to produce a small increase in the quantity of candidate waste for a GDF (depending on the number of new nuclear power stations constructed and operated). A GDF's above ground facilities might need to be slightly larger, and the potential impact on habitats may be slightly increased by the additional quantity of ILW from new build power stations. Local impact assessments in support of site selection and design will seek to prevent and mitigate any such identified effects.

The disposal of ILW at a GDF will require the construction of an appropriate engineered facility to minimise discharges to the environment. The risk of harm from radioactivity will be ALARP.The Government has noted that they expect that any eventual radioactivity reaching the surface of a GDF would be insignificant compared to background levels[125].

10. Radioactive emissions to air from ILW disposal in a GDF could have an indirect effect on biodiversity and ecosystems. However, the assessment of effects on air quality (see previous section) concludes that radioactive emissions associated with interim storage facilities will have a negligible effect on air quality. The air quality section also discusses how a GDF will be an "engineered underground containment facility" and will be designed to minimise the risks from radioactivity[126].

11. There is the potential for long-term positive effects on biodiversity at sites where ILW is stored and disposed of, as security and safety controls will reduce human access to the sites and therefore disturbance. This has been evident on existing Nuclear Licensed Sites in the UK[127].

12. Nirex[128] has previously identified the activities causing impact throughout the lifecycle of the GDF. This preliminary assessment was based on CoRWM's waste inventory[129] and did not include additional quantities of ILW or spent fuelarising from a programme of new nuclear power stations. Nirex identified that the greatest area of disturbance may occur during construction and waste emplacement and estimated that the approximate surface site area of a disposal facility for HLW/SF or ILW/LLW

[125] MRWS White Paper page 27
[126] MRWS White Paper page 27
[127] Environment Agency (EA) The Environment Agency's Assessment of BNFL's 2002 Environmental Safety Cases for the Low-Level Radioactive Waste Repository at Drigg. NWAT/Drigg/05/001 (Version: 1.0) (2005).
[128] United Kingdom Nirex Limited (Nirex), Technical Notes: Summary Note for CoRWM on the Physical Disturbance for Deep Geological Disposal, Phased Deep Geological and Deep Borehole Disposal, Report No: 488235,(October 2005) page 17
[129] Committee on Radioactive Waste Management, "CoRWM's Radioactive waste and `materials inventory", July 2005, CoRWM Document Number 1279.

would be:

- 1,200m x 1,200m per repository
- 1,600m x 1,200m if the repository is co-located

Summary of Potential Effects:

Timescale	C	O	D
Significance	-	+?	+?
Likelihood	M	H	M

Potential Effects

- Potential for minor negative effects during construction of the interim storage facility because of disruption of habitat.
- Potential for minor long-term positive effect from exclusion of public from areas used for interim storage of ILW.

Potential Mitigation and Monitoring

- Biodiversity Survey as part of BAP
- Ecological Impact Assessment

ILW: Climate change

AoS Objective:

to minimise greenhouse gas emissions

Guide questions:

Will it take account of future effects and risks of climate change for example. sea level rise?
Will future changes in weather patterns be considered?
Will it result in increased vehicular emissions (particularly carbon dioxide)?
Will the development result in an overall reduction in greenhouse gas emissions over its life time resulting from changes in:

- Transport of people and goods
- Scope, form and methods of asset construction, maintenance and demolition
- Waste recycling and disposal
- Land management practices
- Other secondary activities in the wider local and national economy

Note: Adaptation to climate change is discussed in other relevant topic appraisals, for example, biodiversity, water, flood risk.

Potential Receptors:

- Human population and natural environment at all geographical scales.

Potential Significant Effects and Mitigation Possibilities:

International/ National/Transboundary

1. The transport of ILW from the site of a new nuclear power station to a GDF will result in the generation of carbon dioxide. An increase in waste volumes is likely to generate additional carbon emissions through the transport of waste consignments for disposal. However the volume of ILW arisings from new nuclear power stations is expected to be small in relation to the volume

of legacy ILW. In the context of current radioactive transfers of half a million radioactive packages per year in UK[130] and 255 billion freight t km in 2007[131], the additional transfers due to ILW from new nuclear power stations is expected to be insignificant. Transport by rail would reduce CO_2 emissions compared to road transport.

2. Although the effects of greenhouse gas emissions will be felt globally, the emissions during construction, operation and decommissioning will largely be determined by regional and local factors, for example local transport infrastructure and the location of the site will affect transport emissions. Impacts are not considered particularly sensitive to site location other than the distance waste may have to be transported and perhaps the mode of transport.

3. Emissions from the transport of ILW are not considered to have a strategically significant effect on climate change because of the relatively small amount of transport involved. The management of ILW will be a minor component of the nuclear power station's lifecycle. Mitigation measures can be established at each phase of the lifecycle. A GDF itself may be designed for both legacy waste and waste from new nuclear power stations and, if so, ILW from new build will have a small effect on the overall size of the facility and hence carbon burden. The overall impact will still be dominated by legacy wastes and spent fuel from new nuclear power stations. ILW from new nuclear power stations will be a minor component.

Regional/ Local

3. The transport of ILW waste to a GDF will result in the generation of CO_2. Whilst largely determined by local effects these impacts will contribute to a global impact but at a scale that is not considered to be strategically significant.

4. The transport of ILW may impact upon the Local Climate Change Action Plans. Consideration may be given to these during further site studies through the production of Environmental Impact Assessments (EIA).

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	+?	-?
Likelihood	L	L	L

[130] Health Protection Agency (HPA), Hughes JS *et al*, (2006), Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK, HPA-RPD-034, http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1204286185596
[131] Department for Transport (DfT), Transport Trends 2009 Edition, (2009), http://www.dft.gov.uk/pgr/statistics/datatablespublications/trends/current/

Potential Effects	Potential Mitigation and Monitoring
• Construction activity will produce an increase in greenhouse gas emissions, but will make only a relatively small addition to the regional inventory of emissions. • Transportation of ILW will produce an increase in greenhouse gas emissions, but will only make a relatively small addition to the regional inventory of emissions. • During operation, nuclear power stations will have a significant positive effect as they provide a low carbon source of energy. By enabling power station operation, interim storage of ILW will make a contribution to this effect. However, as management of ILW is only one aspect of power station operation, it is assessed as only having a minor positive effect.	• Consider the implications of waste transports on Local Climate Change Action Plans • Future legislation is expected under the Climate Change Act 2008, which will require any industry to demonstrate their carbon footprint from cradle to grave. "Organisations that meet the qualification criteria, which are based on how much electricity they consumed in 2008, will be obliged to participate in CRC. Participant organisations will have to monitor their emissions and purchase allowances, sold by Government, for each tonne of CO_2 they emit"[132] • Use of rail transport for ILW movements • Consideration of mitigation measures during design and construction phases of interim storage • Consideration of lifecycle analysis for ILW cycle including interim storage and disposal

[132] Carbon Reduction Commitment, DECC website, http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

ILW: Communities: Population, Employment and Viability

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it create significant pressure on local / regional / National Radioactive Waste Management Facilities?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Community hosting GDF
- Communities in proximity to new nuclear power station sites

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. No international / National / Transboundary effects anticipated.
Regional/ Local 10. Previous studies completed for the NDA on Geological disposal options for HLW and spent fuel disposal[133] concluded that it was difficult to meaningfully discuss the detailed impact of a GDF concept on a local community in the absence of a specific site. Generic statements could be made and this is also the approach adopted for this appraisal. 11. Design and construction of onsite interim storage facilities for ILW at new nuclear power stations will require skilled labour. This may be drawn from the local community but may also be sourced from elsewhere in the UK or from abroad. In either case the employment opportunity created should have a positive effect on the local community in the short term, both financially and socially. 12. The operation of interim storage facilities for ILW will generate additional employment opportunities at the new nuclear power station site. Such jobs are likely to be high quality, but a relatively small fraction of the total number required for operation of the nuclear power station. 13. Additional employment opportunities may be created in the supply chain for example relating to the manufacture of ILW transport or disposal packages. 14. The Government is undertaking a GDF site selection process based on voluntarism and partnership, through the MRWS programme. The purpose of this is to ensure that there is a shared and common understanding with communities of the implications of hosting a GDF, and to develop an engagement and benefits package to ensure that community needs are addressed.[134]

[133] Nuclear Decommissioning Authority (NDA), Geological Disposal Options for High Level Waste and Spent Fuel, Final Version (January 2006).
[134] Summarised from MRWS White Paper

15. Construction of a GDF will require skilled labour. The MRWS White Paper[135] recognises significant employment opportunities may be created through the construction and operation of a GDF: "Construction and operation of a geological disposal facility will be a multi-billion pound project that will provide skilled employment for hundreds of people over many decades. It will contribute significantly to the local economy and wider socio-economic framework". The MRWS White Paper also notes that "it is also likely to involve major investments in local transport facilities and other infrastructure, which would remain after the facility has been closed."[136]

16. Further examination of the employment opportunities, and the impact on community viability and population, should be addressed once the nature and extent of onsite interim storage facilities and a GDF are developed. Application of the English Partnership Additionality Guide is recommended during specific AoS and perhaps BPEO/BPM or BAT[137] studies. An indicative number of staff for the normal operation of a power station (UK-EPR) is between 200 – 300 workers depending on the operator, rising to 1000 during outage[138]. On-site opportunities related to ILW management will be a small proportion of this total figure.

Summary of Potential Effects:

Timescale	C	O	D
Significance	+	+	+
Likelihood	H	H	H

Potential Effects

- There is potential for minor positive effects on the economy through additional employment opportunities associated with the construction and operation of the interim ILW storage facilities. However, the effect of interim storage on employment will be small in relation to the effect of other aspects of construction and operation.

Potential Mitigation and Monitoring

- Additional examination of impact on employment, viability and population during site specific studies associated with interim storage.

[135] MRWS White Paper , page 28
[136] MRWS White Paper page 59,
[137] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).
[138] Department of Energy and Climate Change (DECC), Cm 7386, The Justification of Practices Involving Ionising Radiation Regulations 2004, Consultation on the Nuclear Industry Association Application to Justify New Nuclear Power Stations, Volume 3, Appendix B, Annexes to the Application (December 2008)

ILW: Communities: Supporting Infrastructure

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Local Communities
- Road and rail infrastructure

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. National Rail Infrastructure (and to a lesser extent road transport for transfer to railheads) may be required to transport ILW for geological disposal. The volume of ILW arisings from new nuclear power stations is expected to be small in relation to the volume of legacy ILW. In the context of current radioactive transfers of half million radioactive packages per year in UK[139] and 255 billion freight t km in 2007[140], the additional pressure on the UK Transport Infrastructure would be minimal. 2. ILW is expected to be stored and disposed of within the UK and hence should not impact on international or transboundary infrastructure.
Regional/ Local 3. There is the potential for negative effects on local infrastructure (for example, schools, hospitals or housing) as a result of increases in the local workforce during construction and operation of interim storage facilities at power stations. However, the number of jobs directly related to the interim storage of ILW will be a relatively small fraction of the total number required for the construction and operation of new nuclear power stations. 4. Transport of ILW for final disposal to a GDF would have an impact on local road transport and rail or road transport infrastructure in the vicinity of the storage and final disposal sites. Provided sufficient investment is made in improvements to local rail and road infrastructure during the construction of a new nuclear power station and the construction of a geological disposal facility, in both cases there could be a net benefit. 5. In relation to a GDF, the MRWS White Paper stated that: “There could be spin-off industry benefits, infrastructure benefits, benefits to local educational or academic resources, and positive impacts on local service industries that support the facility and its workforce. It is also likely to involve major investment in local transport facilities and other infrastructure, which would remain

[139] Health Protection Agency (HPA), Hughes JS *et al*, (2006), Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK, HPA-RPD-034, http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1204286185596
[140] Department for Transport (DfT), Transport Trends 2008 Edition, (2008) http://www.dft.gov.uk/adobepdf/162469/221412/190425/220778/trends2008.pdf page 66

after the facility had been closed"[141]. The disposal of ILW from new nuclear power stations in a GDF will contribute to these benefits of a GDF, but as a only a small component of the higher level waste to be disposed of, the benefits attributable to ILW from new nuclear power stations are not considered to be significant.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Potential Effects

- Given the relatively small volumes of ILW generated during the operation and decommissioning of new nuclear power stations significant impacts on national infrastructure are considered unlikely.
- The infrastructure required to support the construction of nuclear power stations should be sufficient to support the requirement for transporting ILW.

Potential Mitigation and Monitoring

- GDF site selection process
- Transport Safety Assessment
- Stakeholder engagement

[141] MRWS White Paper, page 59

ILW: Health and Well-Being

AoS Objective:

to avoid adverse impacts on physical health
to avoid adverse impacts on mental health
to avoid the loss of access and recreational opportunities, their quality and user convenience

Guide questions:

Will it adversely affect the health of local communities through accidental radioactive discharges or exposure to radiation?
Will the storage of radioactive waste result in adverse physical and mental health effects for local communities?
Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?
Will it adversely affect the health of the workforce?
Will it impact upon different vulnerable communities locally?
Will it help to reduce health inequalities?
Will the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities?
Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?

Potential Receptors:

- Local, Regional, European, International populations

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. Storage and disposal of ILW is assumed to be within the UK hence no direct effect on the health and well-being of populations outside the UK anticipated.

3. The Euratom Treaty limits radiation doses to human populations of EU member states from radioactive discharges to 1mSv per year. The annual public doses received by the most exposed individual in the UK from the existing water cooled power station at Sizewell B, where ILW is currently stored, are very much lower than this limit (see Regional/Local Section below). Hence it is anticipated that radiation doses received in member states will have no significant health implications.

4. Whilst certain groups within neighbouring countries may have some concerns about the development of new nuclear power stations in the UK, the impact on the collective community well-being of populations outside the UK is expected to be minimal.

Regional/ Local

12. The emplacement of ILW at an operational GDF has the potential to result in radioactive discharges which may pose a minor risk to the health and well-being of both the workforce and public in the vicinity of sites. A GDF will be designed to ensure that the risks arising from radioactive releases would be acceptable[142].

13. During the construction of an onsite ILW interim storage facilities there is potential for elevated noise and dust levels, which has the potential to have minor negative effects locally on the health and wellbeing of construction workers. This will be regulated under the prevailing regulatory framework and subject to site-specific impact assessment where mitigation can be identified. Similar effects may arise during construction of a GDF.

14. The interim storage of ILW on-site has the potential to increase the level of radiation exposure to the workforce. The strict regulatory framework to control the level of exposure to workers and the public should reduce potential health impacts to acceptable levels and ensure that radiation doses are well within internationally agreed limits. These exposures will be ALARP

[142] MRWS White Paper page 27

and result in acceptable levels of increased stochastic effects[143,144,145]. EA regulatory requirements will ensure that BPEO/BPM or BAT[146] is applied.

15. The Sustainable Development Commission[147] concluded that the health impacts of well managed nuclear power facilities are small (particularly in comparison with other energy sources). This assessment recognises the potential issues associated with waste disposal and decommissioning.

16. Future on-site interim storage and geological disposal of ILW will be regulated by the EA under Environmental Permitting Regulations 2010 (EPR 10) and will require site operators to demonstrate BPM/BPEO or BAT[148] and ALARP (have been and will continue to be applied) measures are in place.

17. There will be an increased risk of radiation exposure of the workforce at a GDF from the addition of ILW from new nuclear power stations to the inventory of waste materials to be disposed of. These exposures will be ALARP and within regulatory requirements and result in acceptable levels of increased stochastic effects.[149,150,151]

18. The MRWS White Paper[152] said:

"The facility will be designed so that natural and man-made barriers work together to minimise the escape of radioactivity. It is inevitable that some radioactivity from the facility will eventually reach the surface. But the disposal facility will be designed to ensure that risks arising from such release would be insignificant compared to the levels of radioactivity all around us in the environment from natural background sources. The natural process of radioactive decay over time will assist this aim."

[143] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York, (2000).
[144] Health and Safety Executive, Work with Ionising Radiation, Guidance on the Ionising Radiation Regulations 1999, L121, (2000).
[145] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[146] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).
[147] Sustainable Development Commission, The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006).
[148] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).
[149] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York, (2000).
[150] Health and Safety Executive, Work with Ionising Radiation, Guidance on the Ionising Radiation Regulations 1999, L121, (2000).
[151] European Commission Council Directive 96/29/Euratom of 13 May 1996 Laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[152] MRWS White Paper page 27

19. The impact of the interim storage and eventual geological disposal of ILW from new nuclear power stations on the health and well-being of workers and members of the public is therefore expected to be minimal. EA Technical Guidance (such as in Technical Guidance notes) will ensure that BPEO/BPM or BAT[153] is applied.

20. The decommissioning of ILW interim storage facilities has the potential to have impacts on the health and well-being of workers. These impacts include both the risks associated with conventional demolition (for example, injuries from falling materials and construction plant) and risks of accidental radioactive releases. The prevailing regulatory framework will apply and all doses will be ALARP.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Potential Effects

- Construction and decommissioning of interim storage facilities may produce negative impacts due to the risks of accident and injury to the workforce. However, because these potential effects are localised they are not considered to be strategically significant.
- Neither are the potential positive effects of employment on health and well-being considered of strategic significance because of the relatively small proportion of the power station's workforce that would be engaged on construction and operation of the interim storage facility.
- Therefore, the effects overall are considered to be neutral.

Potential Mitigation and Monitoring

- Mitigation of effects during construction and decommissioning by adoption of suitable techniques including: risk assessment, production of health and safety plans and compliance with CDM requirements
- Radioactive Discharge and Environmental Monitoring required by Site Specific Authorisations under RSA93 and reported in CEFAS[154] and Pollution Inventory.

[153] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT)
[154] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).

	• Improved abatement technologies current guidance in Environment Agency TGN M11[155] and M12.[156]

[155] Environment Agency, Technical Guidance Note M12 http://www.environment-agency.gov.uk/static/documents/5-PMHO1299BKHG-e-e.pdf
[156] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

ILW: Landscape and Cultural Heritage

AoS Objective:

to avoid adverse impacts on the internationally and nationally important features of the historic environment
to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
to avoid adverse impacts on nationally important landscapes
to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness

Guide questions:

Will it adversely affect landscapes within or immediately adjacent to a National Park?
Will it adversely affect landscapes in or immediately adjacent to an AONB or NSA?
Will it adversely affect Heritage Coast or Preferred Conservation Zones?
Will it adversely affect local landscapes/townscapes of value?
Will it affect the levels of tranquillity in an area?
Will it adversely affect the landscape character or distinctiveness?
Will it result in increased levels of light pollution?
Will it adversely affect historic sites of international/national importance and their setting?
Will it adversely affect other historic sites of known value?
Will it adversely affect landscapes of historic importance?

Potential Receptors:

- Built heritage, archaeology and historic landscapes of local to international importance

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. The potential sites for new nuclear power stations include locations where effects on landscape or cultural heritage designations of national importance cannot be ruled out. However, the additional impact from constructing and operating facilities for managing ILW at nuclear power station sites is likely to produce only minor additional effects as interim storage of ILW will take place within the footprint of the nominated site.

Regional/ Local

6. There is recognition that the siting of many new nuclear power stations is likely to make some use of existing nuclear sites, thereby largely limiting landscape and visual impacts to areas affected by existing power stations. The onsite management and interim storage of ILW may require a number of new facilities to be commissioned. Such facilities will be subject to the prevailing planning requirements and hence developments will be supported by appropriate assessments. All plans, whether on existing or new nuclear licensed sites, will need to prepare specific visual and landscape management plans.

7. The development of interim storage facilities for ILW will be considered as a component of the overall reactor site. The Nuclear Industry Association has estimated[157] that the footprint of an EPR is approximately 250,000m^2. The reactor building is approximately 60m high and the stack extends a few meters above this. It is expected that the actual height of this will be determined by a site specific assessment. The AP1000 plant typically consists of a fenced area of approximately 10 ha (100,000 m^2). Building heights range from 100m for the containment and 44m for the turbine hall to 11m elevation for the Radwaste store[158]. Total land use is estimated to be in the range of 50 – 70 hectares. A waste store will be a small proportion of the overall facility and will therefore have a minor negative effect on landscape.

8. It is expected that a GDF will require a variety of surface facilities, including administration, support buildings, and possibly a waste encapsulation plant and visitor centre[159]. Therefore there is the potential for a minor negative effect on the landscape, if new build waste were to be accommodated in the same facility as legacy waste and this were to increase the size of the above ground facility at a GDF.

[157] The Justification of Practices involving ionising Radiation Regulations 2004 Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations volume 3, appendix B: Annexes to the application (December 2008), http://www.berr.gov.uk/files/file49349.pdf page 68
[158] The Justification of Practices involving Ionising Radiation Regulations 2004 Consultation on the Nuclear Industry Association's Application to Justify New Nuclear Power Stations volume 3, appendix B: Annexes to the application (December 2008), http://www.berr.gov.uk/files/file49349.pdf page 68
[159] MRWS White Paper page 71

9. The MRWS White Paper[160] states that once a GDF has been filled with waste the shaft and tunnels can be backfilled and sealed and the surface facility decommissioned. The site will be monitored under the prevailing regulatory framework. The site itself may then be reused.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	-?	-?
Likelihood	M	M	L

Significant Effects

- There is the potential for minor negative effects on landscape during the construction and operation of both on site interim storage facilities and a GDF. Once locations and designs are finalised the potential effects of both of these facilities on landscape can be more meaningfully appraised.

Potential Mitigation and Monitoring

- Completion of appropriate environmental impact studies in support of additional disposal facility planning applications
- Completion of appropriate environmental impact studies in support of ILW interim storage facilities at nuclear power stations sites
- Effects may be minimised if location chosen was formerly industrial land or previously housed nuclear facilities
- Landscaping requirement imposed on site by planning requirements
- Design to meet local environmental requirements

[160] MRWS White Paper page 72

ILW: Soils, Geology and Land Use

AoS Objective:

to avoid damage to geological resources
to avoid the use of greenfield land and encourage the re-use of brownfield sites
to avoid the contamination of soils and adverse impacts on soil functions

Guide questions:

Will it result in the compaction and erosion of soils?
Will it lead to the removal or alteration of soil structure and function?
Will it lead to the contamination of soils which would affect biodiversity and human health?
Will it compromise the future extraction/ use of geological/ mineral reserves?
Will it result in the loss of agricultural land?
Will it lead to damage to geological SSSIs and other geological sites?
Will it result in the loss of Greenfield land?
Will it adversely affect land under land management agreements?

Potential Receptors:

- Areas in the vicinity of new power stations designated of geological significance.
- Areas in the vicinity of new power stations where land use could be affected, for example, agricultural land.
- Workforce and local populations in the vicinity of new power stations.
- Ecosystems, in particular designated sites of conservation importance in the vicinity of new power stations.

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. Not significant.
Regional/ Local 1. New nuclear power stations will generate additional ILW (see Annex K: Section 1 for estimated quantities of ILW). ILW will be included in the total waste inventory for geological disposal and this will impact on the overall size of a GDF. Studies supporting the development of a GDF will be required to consider such impacts. 2. The development of interim storage facilities at new nuclear power station sites will require additional land use within the nuclear site licence boundary, although this land is within the overall site area proposed by developers for new nuclear power stations. The exact requirements for land use will be dependent upon the nature and extent of the facilities chosen by the developer. Site-specific Environmental Impact Assessments (EIAs) are more appropriate means of assessing the specific impact of such developments. Where development of interim storage facilities is considered on brownfield sites (which may include contaminated land) additional waste issues may arise as well as the disturbance and creation of pathways for potential contamination. 3. The construction of onsite interim storage facilities for ILW from new nuclear power stations is likely to have a minor negative impact on geology and soils due to removal or alteration of soil structure and possible loss of agricultural or greenfield land. Whether such effects arise will depend on the siting and design of interim storage facilities and the local conditions at the site. 4. Similar types of effects will potentially be produced by construction of a GDF that may comprise surface structures, access to underground tunnels and disposal vaults[161]. The spatial extent and duration of any impacts are likely to be greater at a GDF than for interim storage facilities. The impact of a GDF on geology and land use will be considered during site specific assessments and the contribution of ILW from new nuclear power station sites will be taken into account in these assessments.

[161] MRWS White Paper Annex A

5. The construction and operation of a single co-located GDF would have a smaller environmental impact than the construction and operation of more than one GDF. The MRWS White Paper notes that it would be possible to build more than one GDF, for example, one for ILW/LLW and one for HLW/spent fuel, but the UK Government sees no case for having separate facilities if one facility can be developed to provide suitable, safe containment for the Baseline Inventory[162]. With regard to new build wastes, the Government considers that it is technically possible and desirable to dispose of new waste in the same GDF as legacy wastes and has committed to explore this further through the MRWS process[163]. The MRWS White Paper acknowledged that the size and timing of any programme of new nuclear power stations may have an impact on the amount of any new waste that could be disposed of in the same facility as the legacy waste[164].

6. Where a GDF is developed for co-disposed wastes, the size of the facility will be determined by the inventory of wastes to be emplaced within it. The additional ILW for disposal due to new nuclear power stations with have a small impact on the size of a GDF. The 2007 consultation on the Future of Nuclear Power contained estimates by Nirex of the impact of a new build programme equivalent to ten AP-1000s that would increase the quantity of ILW by around 3%[165].

7. More recent work by NDA means it is now possible to update this estimate The NDA has, as part of their disposability assessments under the Generic Design Assessment (GDA) process, which reported its findings to the "Requesting Parties", produced estimates for the lifetime ILW arisings for the new nuclear power station designs being assessed in the GDA process.

8. The volume of packaged ILW (both operational and decommissioning) produced by an EPR operating for 60 years is estimated to be in the range 2097-3651m3 dependent upon the packaging system used[166]. For an AP-1000 operating for 60 years, the volume of packaged ILW produced is estimated[167] to be 3450m3

9. NDA has considered the potential impact on the size of a GDF of the disposal of ILW from a single new nuclear reactor and from a 10GW new nuclear programme. 10 GW equates to nine AP-1000 reactors or six EPR reactors. The volume of ILW for disposal is subject to some variation depending on assumptions regarding packaging and conditioning technologies that might be adopted by future operators, but NDA has concluded that in all cases the necessary increase in the GDF "footprint area" is

[162] MRWS White Paper page 29
[163] Nuclear White Paper page 99
[164] MRWS White Paper page 29
[165] Nuclear White Paper page 135.
[166] Disposability Report for the EPR Tables B3-B6
[167] Disposability Report for the AP-1000 Table B1

small.

10. For the AP-1000 the necessary increase in the GDF "footprint area" corresponds to approximately 65m of disposal vault length per reactor. This represents approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of 9 AP-1000 reactors.

11. The findings are similar for the EPR, where NDA has calculated that each EPR would require an additional 60m of disposal vault length, representing approximately 1% of the area required for the legacy ILW, per reactor, and less than 10% for the illustrative fleet of six EPR reactors.

12. Whilst there is the potential for a minor negative effect on geology, soils and land use at the nominated sites for a GDF, this will be subject to further assessment during design and development and the impact of a GDF on geology land use and soils will be considered during site specific assessments and the contribution ILW from new nuclear power station sites, whilst important, is unlikely to be significant. The NDA is currently evaluating the disposability of waste from the new nuclear power stations.

13. The NDA has started exploring the engineering possibilities for a geological disposal facility. The NDA[168] has evaluated a range of geological concepts for a GDF and stated that it is not appropriate at this stage of the siting programme to select a preferred option. Development of a GDF will continue and it is during this process that the overall impact on soils, geology and land use can be fully evaluated.

14. The closure of a GDF and decommissioning of interim storage facilities will impact soils, geology and land use. The impacts of decommissioning interim storage facilities are likely to be positive as it may be possible to return soils, geology and land use to conditions similar to those before construction.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	-?	-?
Likelihood	M	M	M

[168] "Concepts for the Geological disposal of Intermediate level Radioactive Wastes, Hicks, Baldwin, Hooker, Richardson, Chapman, McKinley, Neall, Report 0736-1, April 2008.

Potential Effects	Potential Mitigation and Monitoring
• New interim storage facilities will be required at new nuclear power station sites. The impact on soils, land use and geology will be dependent on the interim storage option chosen and on local conditions at the site but it is possible that minor negative effects on soil structure and geology may arise within the footprint of the store. • Contamination of soil adjacent to the interim store should not arise provided that the facility is constructed and operated in accordance with best practice.	• Site-specific EIA or other studies to support development of interim storage facilities • Continued monitoring of the facility during construction and operation to identify potential changes to soils and geology as a result of the development

ILW: Water Quality and Resources

AoS Objective:

to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology)
to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives
to avoid adverse impacts on the supply of water resources
to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives

Guide questions:

Will it result in the increased sedimentation of watercourses?
Will it adversely affect channel geomorphology?
Will hydrology and flow regimes be adversely affected by water abstraction?
Can the higher defence standards be achieved without compromising habitat quality and sediment transport?
Will it result in the sediment loading of watercourses?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it affect designated Shellfish Waters?
Will it affect Freshwater Fish Directive sites?
Will it increase turbidity in watercourse?
Will it increase the temperature of watercourses?
Will it adversely affect water supply as a result of abstraction?
Will it significantly increase demand for water?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local water resources both surface water and groundwater relevant to interim storage and final disposal sites
- National and international coastal environment identified in site specific reports
- Sensitive marine and freshwater habitats, identified in site specific reports

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. Flooding of any facility located close to the coast is a possibility with sea level rises predicted as a result of climate change. Although the ILW will be securely contained when placed in interim storage, flooding of this facility would hamper operations and could lead to deterioration in the condition of the stored ILW packages. Therefore, mitigating measures to prevent flooding of interim stores containing ILW may need to be included in the plant design. This provision would avoid the risk of contamination of the marine environment that could otherwise lead to national or transboundary effects.

Regional/ Local

7. ILW will not be present during construction; therefore a direct impact is not anticipated.

8. As noted under International/National/Transboundary effects, flooding of ILW storage facilities at power stations could potentially lead to a small risk of contamination of local surface water and/or groundwater. It is currently Government policy for any new development to submit a FRA alongside any planning application as stated in paragraphs 10-13 of Planning Policy Statement 25. This process ensures that all aspects of flood risk are assessed prior to construction. A FRA takes into account the facilities size, design, building use and construction material, as well as all aspects of drainage, local coastal and fluvial systems and investigates any alternative mitigation options. The FRA would be encompassed within the overall assessment for the nuclear power station and this would provide intervention for ILW interim storage facilities.

9. Under the Nuclear Installations Act 1965 a safety case will be required for the operation of an interim storage facility. As part of this an investigation into the release of radionuclides into the environment will be undertaken. This will account for affects to the local marine and freshwater environment as a flooding event is a foreseeable accident. Monitoring of these environments will include turbidity tests and water flow may also be performed as part of the RSA 1993 authorisation held by the site.

10. There is a potential that waste emplaced in a GDF could interact with the local groundwater systems due to the large timescales involved. Groundwater contact with disposed ILW containers could potentially damage the integrity of the engineered canisters and also provide a pathway for contaminates to be released into the environment. Facilities in Europe have completed comprehensive research and development examining geological disposal and specifically the characteristics of groundwater at their specified sites prior to ILW disposal. The UK would follow similar methods in investigating the suitability and final siting of a disposal facility. [169]

11. As part of the licensing process for a GDF, investigations into the release of radionuclides into the environment will be undertaken. This will take into account effects to the local groundwater and freshwater environment as a flooding event is foreseeable. Monitoring of these environments including water flow and effects to the local environment should also be performed as part of the RSA 1993 authorisation held by the site.

Summary of Potential Effects:

Timescale	C	O	D
Significance	-?	-?	-?
Likelihood	L	L	M

Potential Effects

- Potential contamination of surface and groundwater from non-radioactive run-off during construction of interim storage for ILW.
- Potential damage to interim storage facility in the event of flooding, leading to deterioration in condition of waste packages and possible risk of contamination of surface or ground waters.

Potential Mitigation and Monitoring

- Construction design/location for new facilities taking account of FRA will minimise the potential possibility of flooding of a site and their effects should flooding occur.
- Advances in designs to include monitoring

[169] MRWS White Paper page 27.

	and abatement techniques preventing the release of contamination into the environment (Environment Agency TGN M12[170]). • Monitoring of the local environment is a requirement under Environmental Permitting Regulations 2010 for large Nuclear Licensed sites. Any effect to the local environment is therefore monitored and recorded.

[170] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

Flood Risk

AoS Objective:

14. To avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible

Guide questions:

Will it result in demand for higher defence standards?

Potential Receptors:

- Site workers
- Local/ District ecosystems in coastal waters

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

Regional/ Local

4. The onsite interim storage of ILW will be provided within the footprint of the nuclear power station site. The site-level appraisals have highlighted the need to undertake site-specific investigations, including flood risk assessment, to determine the most appropriate and sustainable methods for protecting sites from flooding. The measures taken to protect nuclear power stations from flooding will also serve to protect the ILW interim storage facilities.
5. To mitigate against potential negative effects on coastal processes if flood protection measures are required they must be designed, constructed and managed so as to minimise any negative impacts.
6. An increase of impermeable surfaces as a result of a new power station could increase surface water runoff, which has the potential to increase the risk of flooding to the surrounding area. However, the interim storage facility will occupy only a small part of the site and so its contribution to this aspect of flood risk will not be great. A Flood Risk Assessment (FRA) would identify any potential problems with increased surface run-off caused by the introduction of a new facility and mitigation techniques may be required to be identified before planning permission is granted.

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	H	H	H

Significant Effects

- Provided that interim storage facilties for ILW are within the footprint of the site, the effect of ILW storage on flood risk during construction and operation should not alter the measures required to protect other facilities on the site.

Mitigation and Monitoring Possibilities

- Any effects arising from flood protection measures could potentially be mitigated through appropriate design, construction and management.

Section 5 Appraisal Matrices: Low Level Waste (LLW)

Notes on Appraisal approach

8. The discussion of potential effects and mitigation possibilities includes both the effects of waste management at nuclear power station sites, transport offsite and effects at the site for final disposal of the waste where applicable.
9. The Summary of potential effects for each topic includes the effects of waste management at nuclear power station sites and transport offsite only.
10. The Summary of potential effects is carried to the summary tables for each waste type that are presented in Section 6 of the Main AoS.

Key to Appraisal				
Key to appraisal of Strategic Effects:			**Abbreviations:**	
Significance		**Category of effect**	**Timescale**	
++	Major Significant	Development actively encouraged as it would resolve an existing sustainability problem. Effect considered to be of national/ international significance.	C	Construction stage
+	Minor Significant	No Sustainability constraints and development acceptable. Effect considered to be of national/ international significance.	O	Operation stage
0	No significance	Neutral effect	D	Decommissioning stage
-	Minor Significant	Potential sustainability issues; mitigation and / or negotiation possible. Effect considered to be of national/ international significance.	**Likelihood**	
--	Major Significant	Development problematical because of known sustainability issues; mitigation or negotiation difficult and/ or expensive. Effect considered to be of national/ international significance.	H	High Likelihood
?	Uncertainty	Where the significance of an effect is particularly uncertain, for example because insufficient information is available at the plan stage to fully appraise the effects of the development or the potential for successful mitigation, the significance category is qualified by the addition of '?'.	M	Medium Likelihood
			L	Low Likelihood

LLW: Air Quality

AoS Objective:

To avoid adverse impacts on air quality

Guide questions:

Will it result in the release of low level radionuclides that may adversely affect human health or biodiversity?
Will it contribute to an increase in the number or expansion of Air Quality Management Areas (AQMAs)?

Potential Receptors:

- Local populations and wider regional population (human health)
- National and International population where LLW is treated.
- Sensitive habitats, identified in site specific reports

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. UK LLW policy[171] sets out the circumstances where the export (or import) of LLW waste[172] would be permitted. Permissible reasons for exporting LLW are: for the recovery of re-useable materials; or for treatment that will make its subsequent storage and disposal more manageable. In all cases where such processes would add materially to the wastes needing to be disposed of in the country of destination, the presumption should be that they will be returned to the UK, to a timescale agreed by regulators and competent authorities.

[171] DEFRA, Policy for Long-Term Management of Solid Low Level Radioactive Waste in the United Kingdom, DEFRA, DTI, and the Devolved Administrations, (March 2007).
[172] With the exception of certain special permitted circumstances

2. During operation and decommissioning the facilities may generate wastes (for example, soft wastes for incineration or metals for recycling) that are consigned overseas for treatment with the residual waste returned to the country of origin. Such treatment operations may impact on local air quality but will be required to meet the ALARA principle[173] and the prevailing regulatory framework established by the host country. Experience at overseas facilities currently operating indicates that the potential for negative impact is minimal.

3. Transport of radioactive waste overseas may impact air quality due to nonradiological emissions from transport vehicles. This significance of the impact will be dependant on the number of journeys and the mode of transport and in the context of new nuclear power station is not likely to be significant.

Regional/ Local

1. LLW is not expected to be present during construction, although there is a small risk that radiologically contaminated soil could be found at sites for new power stations if these sites adjoin or include existing nuclear power stations or other nuclear facilities where contamination has occurred in the past (see for example[174]) If so this material may need to be removed during construction of a new power station. However, it is assumed that treatment or removal of any such contamination would be undertaken as part of the decommissioning of existing nuclear facilities, regardless of whether a new power station is proposed. Therefore, the impact on air quality from the treatment or transport of LLW during this phase is considered neutral.

2. The UK has an established regulatory regime supported by independent regulatory bodies; the Nuclear Installations Inspectorate (NII) and Environment Agency (EA). The NII licenses nuclear sites for the Health and Safety Executive (HSE). The NII's mission is to secure effective control of health, safety and radioactive waste management at nuclear sites for the protection of the public and workers under the Nuclear Installations Act 1965. The accumulation of waste is regulated by the NII and the impact of this is subject to comprehensive assessment and evaluation.

[173] making sure a risk has been reduced through weighing the risk against the sacrifice needed to further reduce it
[174] NDA UK Nuclear LLW Strategy: Site Specific Baselines, Part III Wales, June 2009, http://www.nda.gov.uk/documents/upload/UK-Nuclear-LLW-Strategy-Site-Specific-Baselines-Part-III-Wales-June-2009.pdf

3. Radioactive releases from operational sites are authorised by the Environment Agency under the Environmental Permitting Regulations 2010[175] (EPR 10). Releases are required to be ALARP[176] and monitored and managed in accordance with documented arrangements approved by the EA. In addition to the RSA authorisation, sites will be required to complete an Article 37 submission[177], a requirement of the Euratom Treaty, which seeks to understand the impact of radioactive emissions on EU member states.

4. A permit under the Environmental Permitting Regulations requires the site operator to apply Best Practical Environmental Optional (BPEO) and/or Best Practicable Means (BPM) to minimise waste arisings. Such techniques or the implementation of Best Available Technique (BAT)[178] to the new nuclear power stations programme will seek to minimise operational LLW.

5. Approximately 80,000m^3 (packaged volume) of LLW is estimated to be generated from a programme of 10 AP1000 reactors (10GW over 60 years)[179]. This equates to approximately 8000 individual journeys over the lifetime of the programme, which is a relatively small component of the overall transport burden associated with the new build programme. When considered in the context of other LLW arisings of around 500-700 containers per year, in addition to occasional large items for disposal, this is considered to pose only a minor additional impact on air quality during the operational phase.

6. Transport emissions associated with the movement of operational and decommissioning LLW cannot be discounted. The impacts of such emissions are expected to be of minor significance given the level of waste arisings indicated in the Generic Design Assessments[180]. The carriage of radioactive materials is regulated by International agreements and UK regulation (for example Carriage of Dangerous Goods Regulations 2007).

7. Rail transport should be considered in order to minimise impacts on air quality resulting through LLW transport during the

[175] Under the Better Regulation initiative, the Environmental Permitting Programme (EPP) is a joint Defra, DECC, Welsh Assembly Government and Environment Agency initiative to streamline waste management licensing and pollution prevention control regimes. RSA93 will be updated under the EPP programme in 2010.
[176] As Low As Reasonably Practicable
[177] If an EU Member State alters the way in which it plans to dispose of radioactive waste, seeks to reduce restrictions on discharges, or has a new facility which may increase emissions it must make a submission to the Commission seeking an opinion on the proposals.

[179]Sustainable Development Commission The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006) page 53
[180]Generic Design Assessment Guidance to Requesting Parties http://www.hsfor exampleov.uk/newreactors/ngn03.pdf

operational phase

8. Where waste is treated, such facilities will also require permitting by the Environment Agency under the Environmental Permitting Regulations 2010 in the UK. Such sites would also be expected to apply BPEO/BPM[181] or BAT[182] under the existing arrangements. Whilst there is expected to be emissions to air regulated limits will apply and impact managed.

Summary of Potential Effects:	Timescale	C	O	D
	Significance	O	-?	-?
	Likelihood	L	L	L

Significant Effects	Mitigation and Monitoring Possibilities
• Transport associated with the movement of LLW to disposal and/or treatment facilities particularly during site operation and decommissioning will have a minor negative effect on air quality.	• Statutory monitoring associated with authorisations • Assessment of alternative transport arrangements for the movement of LLW

[181] The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or least damage to the environment as a whole, at acceptable cost, in the long term well as in the short term. BPM is the term used by the environment agencies in authorisations issued under RSA 1993. It requires operators to take reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposal of radioactive waste so as to achieve a high standard of protection for the public and the environment

[182] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).

LLW: Biodiversity

AoS Objective:

to avoid adverse impacts on the integrity of wildlife sites of international and national importance
to avoid adverse impacts on valuable ecological networks and ecosystem functionality
to avoid adverse impacts on Priority Habitats and Species including European Protected Species

Guide questions:

Will it result in the loss of habitats of international/national importance?
Will it affect other statutory or non-statutory wildlife sites?
Will it result in harm to internationally or nationally important or protected species?
Will it adversely affect the achievement of favourable conservation status for internationally and nationally important wildlife sites?
Will it affect the structure and function/ecosystem processes that are essential to restoring, securing and/or maintaining favourable condition of a feature or a site?
Will the proposal enable the BAP targets for maintenance, restoration and expansion to be met?
Will the proposal result in changes to coastal evolution that is otherwise needed to sustain coastal habitats?
Will it result in the release of harmful substances, for example, oil, fuel and other pollution into water bodies which could affect aquatic ecosystems?
Will it result in the accidental migration of radionuclides which could harm aquatic or terrestrial ecosystems?
Will it result in changes to stream hydrology and morphology that could affect aquatic or terrestrial ecosystems?
Will it result in thermal discharges that could adversely affect aquatic ecosystems?
Will it result in soil contamination that could damage aquatic or terrestrial ecosystems

Potential Receptors:

- Local, Regional, European, International receptors

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 2. The prevailing regulatory framework controls the impact of discharges resulting from disposal of LLW on Habitats in EU member States[183]. 3. UK LLW policy sets out the circumstances where the export (or import) of LLW waste would be permitted. Permissible reasons for exporting LLW are: for the recovery of re-useable materials; or for treatment that will make its subsequent storage and disposal more manageable. In all cases where such processes would add materially to the wastes needing to be disposed of in the country of destination, the presumption should be that they will be returned to the UK, to a timescale agreed by regulators and competent authorities. As such, no direct effect on habitats outside the UK are anticipated 4. Work is ongoing within the EU on methodologies to assess the impact of ionising radiation on biota. They include: • ERICA[184] (Environmental Risk from Ionising Contaminants: Assessment and Management) which will provide an integrated approach to scientific, managerial and societal issues concerned with the environmental effects of contaminants emitting ionising radiation, with emphasis on biota and ecosystems. • FASSET [185](Framework for assessment of environmental impact of ionising radiation in major European ecosystems) includes: source characterisation; description of seven major European ecosystems; selection of a number of reference organisms on the basis of prior ecosystem and exposure analysis; environmental transfer analysis; dosimetric considerations and effects analysis; • PROTECT [186](Protection of the Environment from Ionising Radiation in a Regulatory Context) will evaluate the practicability and relative merits of different approaches to protection of the environment from ionising radiation and compare these with methods used for non-radioactive contaminants.

[183] For example; EU Habitats Directive (implemented within the UK under the Conservation (Natural Habitats, &c.) Regulations 1994), Countryside and Rights of Way Act 2000 etc.
[184] http://www.ceh.ac.uk/protect/ERICAdeliverables.html
[185] http://www.ceh.ac.uk/protect/FASSETdeliverables.html
[186] http://www.ceh.ac.uk/protect/EPICdeliverables.html

5. By understanding the full environmental impacts of ionising radiation on the environment an improved impact assessment can be developed. It is expected that these methodologies will be used to give a more accurate estimate of the impact of new build power stations than previously possible for existing nuclear facilities

6. Consigning sites and LLW repositories will require EPR 10 Authorisation to dispose of and accept LLW. Before an Authorisation is issued the site must submit an assessment of impact on biota[187] other than humans as part of the implementation of the EU Habitats Directive[188]. This is implemented in the UK by the Conservation (Natural Habitats,) Regulations 1994[189]. It is anticipated that future assessments will utilise the methodologies developed by ERICA, FASSET and PROTECT.

Regional/ Local

1. During construction of LLW management facilities there is the potential for minor negative impacts on Biodiversity relating to provision for LLW, due to effect of disruption of habitat.

2. Biodiversity can be enhanced around power station sites where waste is generated and where LLW repositories are located as Security and Safety controls will reduce human access to the sites and therefore disturbance. Some evidence of this effect at existing Nuclear Licensed Sites in the UK has been provided in submissions for the storage of LLW[190].

Summary of Potential Effects:

Timescale	C	O	D
Significance	-	+?	+?
Likelihood	M	H	M

Significant Effects

Mitigation and Monitoring Possibilities

[187] The animal or plant life of a particular region
188 For example; EU Habitats Directive (implemented within the UK under the Conservation (Natural Habitats, &c.) Regulations 1994), Countryside and Rights of Way Act 2000 etc.
[189] Her Majesty Stationary Office (HMSO), the Conservation (Natural Habitats, &c.) Regulations 1994 Statutory Instrument 1994 No. 2716, (1994).
[190] Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015, Section 11

• There is the potential for a minor negative effect during construction because of disruption of habitat. • There is the potential for a minor significant positive effect from exclusion of the public from power station sites where waste is generated and from areas where LLW repositories are located.	• Biodiversity Survey as part of Biodiversity Action Plan

LLW: Climate change

AoS Objective:

to minimise greenhouse gas emissions

Guide questions:

Will it take account of future effects and risks of climate change for example. sea level rise?
Will future changes in weather patterns be considered?
Will it result in increased vehicular emissions (particularly carbon dioxide)?
Will the development result in an overall reduction in greenhouse gas emissions over its life time resulting from changes in:

- Transport of people and goods
- Scope, form and methods of asset construction, maintenance and demolition
- Waste recycling and disposal
- Land management practices
- Other secondary activities in the wider local and national economy

Note: Adaptation to climate change is discussed in other relevant topic appraisals, egg. Biodiversity, water, flood risk.

Potential Receptors:

- Human population and natural environment at all geographical scales.

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. The transport of LLW waste to disposal and treatment facilities will result in the generation of carbon dioxide. The increase in packaged waste arising from the installation of 10GW of capacity is predicted to be approximately 80,000m^3 for the AP1000 reactor (10 units) and 100,000 m^3 for the EPR reactor (7 units)[191]. If the assumption is made that an average HHISO container of LLW contains approximately 10m^3 of waste and that a single container is moved for each journey this equates to approximately 8000 and 10000 additional journeys for the AP1000 and EPR reactor sites respectively. The current estimates of legacy LLW waste volume is 3.47 million m^3[192,193] which represents 347,000 journeys and hence a 2.3% and 2.9% increase for the AP1000 and EPR respectively. The potential adverse impacts of LLW transports on climate change are of minor significance. Waste generation and hence transport requirements associated with new build are expected to be lower than current operational stations[194].

2. The implementation of the UK LLW policy and, by implication, the waste management hierarchy for operational and decommissioning LLW is likely to have a beneficial effect by reducing the quantity of waste for transport and disposal. This should help to minimise the climate change impacts of these activities.

3. The development of additional LLW waste capacity at the Low Level Waste Repository (LLWR) near Drigg in West Cumbria or alternative disposal sites may result in additional carbon emissions. The NDA estimate for total LLW arisings in 2007[195] is 3.47 million m^3, which equates to an approximate increase of 2.3% and 2.9%. It is expected that this may require an additional limited capacity. However, with the implementation of the UK LLW policy and the waste management hierarchy, the potential impact on current repository capacity could be reduced. This is dependent on an individual new nuclear power station site's adaptation of best practice and the number of new nuclear power stations constructed and operated.

[191] Sustainable Development Commission The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006) page 53
[192] Nuclear Decommissioning Authority (NDA), UK Waste Inventory, http://www.nda.gov.uk/ukinventory/summaries/, (1 April 2007).
[193] Committee on Radioactive Waste Management (CoRWM), CoRWM's Radioactive Waste and Materials Inventory – July 2005, CoRWM Document No: 1279, (July 2005).
[194] Nuclear Decommissioning Authority (NDA) and DEFRA, Radioactive materials not reported in the 2007 Radioactive Waste Inventory, (March 2008).
[195] Nuclear Decommissioning Authority (NDA), Radioactive Waste in the UK: A summary of the 2007 Inventory, (2007).

4. Although the effects of any emissions will be felt globally, the emissions during construction, operation and decommissioning will largely be determined by regional and local factors, (for example local transport infrastructure and how the location of the site will affect transport emissions). Impacts are not considered particularly sensitive to site location other than the distance waste may have to be transported and perhaps the mode of transport. For example, waste from Sellafield may be transported by rail to the LLWR, (current practice) whilst waste generated at Hinkley is more likely to be transported by road (current practice); the associated carbon emissions will therefore be different.

5. The NDA UK strategy for Nuclear Industry LLW focuses on securing long term capacity at the LLWR. As part of this strategy LLWR Ltd is seeking to establish alternative waste management options, including segregated waste services for waste treatment and volume reduction. Following application of the waste management hierarchy, there is an option of considering disposal of Very LLW (VLLW) at onsite or supply-chain facilities provided the necessary safety assessments can be carried out to the satisfaction of the environmental regulators. This may result in a minor reduction to overall transport impacts. In the context of current UK and future nuclear power station transport requirements this is not considered significant.

Regional/ Local

1. LLW is not expected to be generated during the construction of new nuclear power stations[196] and hence is unlikely to impact on climate change in this phase.

2. The transport of LLW waste to a local or national treatment and disposal facilities will result in the generation of carbon dioxide. In 2004 traffic count data indicated that, on average, 10 HGV trips were made a day through the village of Drigg to the LLWR[197]. Whilst largely determined by local effects these impacts will contribute to a global impact. It is unlikely that infrastructure will be developed solely for the management of LLW but improvements in road and rail networks for example may be developed to support construction or other operational needs.

3. The transport of LLW may impact upon the Local Climate Change Action Plans. Consideration may be given to these during further site specific Environmental Impact Assessments (EIA).

1. [196] See Point 1 under Air Quality for further explanation .

[197] LLWR, LLW Strategic Review, NLWS/LLWR/01Issue 1, January 2009, page 6

Summary of Potential Effects:	Timescale	C	O	D
	Significance	-?	-?	-?
	Likelihood	M	M	M

Significant Effects

- There is the potential for a minor negative effect on climate change as a result of transporting LLW, including options for disposal and treatment this is expected to be minor.
- The implementation of the NDA UK strategy for Nuclear Industry LLW should encourage adherence to UK LLW policy. This includes the adherence to a waste management hierarchy during operation. There is also the expectation that new build facilities will generate less waste and be easier to decommission than existing (older) nuclear power stations. Any adverse impact on climate change is therefore expected to be of minor significance.
- Further information can be found in the NDA's LLW SEA[198].

Mitigation and Monitoring Possibilities

- Adoption of UK LLW policy at new build facilities including application of the waste management hierarchy, BPEO/BPM[199] or BAT.
- Consider the implications of waste transports on Local Climate Change Action Plans
- Future legislation is expected under the Climate Change Act 2008, which will require any industry to demonstrate their carbon footprint from cradle to grave. "Organisations that meet the qualification criteria, which are based on how much electricity they consumed in 2008, will be obliged to participate in CRC. Participant organisations will have to monitor their emissions and purchase allowances,

[198] NDA, LLW Strategic Environmental Assessment, http://www.nda.gov.uk/documents/upload/UK-Nuclear-LLW-Strategy-Site-Specific-Baselines-Part-I-England-June-2009.pdf
[199] The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or least damage to the environment as a whole, at acceptable cost, in the long term well as in the short term. BPM is the term used by the environment agencies in authorisations issued under RSA 1993. It requires operators to take reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposal of radioactive waste so as to achieve a high standard of protection for the public and the environment

	sold by Government, for each tonne of CO_2 they emit"[200] • Life cycle assessment may be required • The minor negative impact on climate change associated with LLW could potentially be offset by the benefit obtained during the operation of the station.

[200] Carbon Reduction Commitment, DEFRA website, http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm

LLW: Communities: Population, Employment and Viability

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it create significant pressure on local / regional / National Radioactive Waste Management Facilities
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Local populations and wider regional population

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Overseas disposal of LLW is restricted by UK policy[201]. However, the potential exists for the use of treatment facilities for Low Level Waste outside the UK. In all cases where such processes would add materially to the wastes needing to be disposed of in the country of destination, the presumption should be that they will be returned to the UK, to a timescale agreed by regulators and competent authorities. A legal framework is in place covering the transport of waste overseas for treatment (Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008)[202]. . Additional employment opportunities may be created in overseas facilties. Extant overseas treatment facilities already process limited quantities of LLW from UK. Such impacts are likely to be insiginificant due to the volumes of waste associated with new nuclear power stations, which are expected to be much lower than the volumes associated with legacy wastes.

Regional/ Local

4. LLW is not expected to be generated during the construction of new nuclear power stations[203] and hence is unlikely to impact on population and employment opportunity.

5. The new nuclear power stations will generate LLW during operations. During operation each individual new nuclear power station will need to employ a number of specialists to characterise LLW to permit disposal at appropriate disposal facilities. Further employment will be created by support operations such as segregation, packing and despatch of LLW. Sub-contractors may also be employed. However, the extent of such employment is likely to be limited. The Generic Design Assessment process[204] suggests that waste will be relatively small (for 10 AP1000's it has been estimated that 80,000m^3 will be produced over its lifetime). This suggests that the employment opportunities and population variations associated with LLW arisings will be insignificant at a regional level.

[201] Policy for the Long Term Management of Solid Low Level Radioactive Waste in the UK, March 2007 http://www.defra.gov.uk/environment/radioactivity/waste/pdf/llw-policystatement070326.pdf page 11
[202] Her Majesty Stationary Office (HMSO), Atomic Energy and Radioactive Substances, The Trans-frontiers Shipment of Radioactive Waste and Spent Fuel Regulations 2008, Statutory Instruments 2008 No. 3087, 2008.
[203] See Point 1 under Air Quality for further explanation .
[204] Health & Safety Executive, Reactor Designs, www.hsfor exampleov.uk/reactors/reactordesigns.htm, accessed 16/03/2009, 2009.

6. Decommissioning of the new nuclear power station may involve the management of LLW arisings, but the potential impact on regional population and employment is likely to be minimal. Activities associated with the disposal of LLW are likely to be incorporated into wider decommissioning activities and it is therefore difficult to quantify the impact specifically associated with LLW with any certainty.

7. The Low Level Waste Repository (LLWR) for the disposal of Low Level Waste is located in West Cumbria. Whilst there are smaller disposal sites elsewhere this National facility is used by existing nuclear power stations and it is expected that new build stations will continue to use this facility or a successor facility. The Base Case, established in the Consultation on the Funded Decommissioning Programme[205] noted that LLW will be disposed of promptly after it has been generated in a suitable disposal facility. Disposal will be at the facility currently operating in West Cumbria or a successor facility[206]. The development of new nuclear power stations is not expected to significantly increase the amount of LLW requiring disposal (see point 1. under Climate Change) although it will extend the period during which LLW from nuclear power stations will be generated and will require disposal. Nevertheless, the positive effects of new nuclear power stations on employment opportunities associated with LLW disposal site operations are not considered to be strategically significant.

8. The NDA UK strategy for Nuclear Industry LLW focuses on securing long term capacity at the LLW repository (LLWR) near Drigg in West Cumbria[207]. As part of this strategy LLWR Ltd is seeking to establish alternative waste management options, including waste minimisation services. Following application of the waste management hierarchy, there is an option of considering disposal of some such material at regional facilities provided the necessary safety assessments can be carried out to the satisfaction of the environmental regulators. The impact of new nuclear power stations on employment opportunities and population at and around such facilities is difficult to assess, although it is likely to be insignificant at a regional level.

1. It is recognised that locally, new nuclear power stations could lead to investment in infrastructure and local services. Employment may be created both temporarily and permanently during the construction of infrastructure supporting LLW disposal. In December 2006 the LLWR supported 132 members of staff[208] although it is difficult to estimate employment impact

[205] http://www.berr.gov.uk/files/file44486.pdf
[206] The Energy Bill, http://www.berr.gov.uk/files/file44486.pdf page 68
[207] NDA, UK Nuclear Industry LLW Strategy, http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-August-2010.pdf
[208] NDA, LLW Strategic Environmental Assessment, http://www.nda.gov.uk/documents/upload/UK-Nuclear-LLW-Strategy-Site-Specific-Baselines-Part-I-England-June-2009.pdf page 45

as jobs created may be at the expense of jobs in other sectors. Application of the English Partnership Additionality Guide is advised.

9. Given the relatively small demands on appropriately skilled labour, supply issues are not anticipated.

Summary of Potential Effects:

Timescale	C	O	D
Significance	O?	O?	O?
Likelihood	L	L	L

Significant Effects

- The effects of LLW on Communities: Population, Employment and Viability are considered insignificant at a regional level. The quantity of LLW generated by operational new nuclear power stations compared with existing ones is likely to be small.
- Positive cumulative effects are considered to be minor. The NDA recognises that the LLWR is a UK strategic asset[209]. Whilst policy development may encourage the development of regional facilities for VLLW and other treatment facilities the driver for this is historic liability.
- Employment opportunities associated directly with LLW management at new nuclear power stations are considered to be of neutral significance at a regional level.

Mitigation and Monitoring Possibilities

- Application of English Partnership Additionality Guide to understand impact of LLW on employment opportunities at Low Level Waste Repository and other potential disposal facilities

[209] http://www.nda.gov.uk/loader.cfm?csModule=security/getfile&pageid=29908 Page 8, 33

LLW: Communities: Supporting Infrastructure

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population? Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Local Communities
- Road and rail infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. It is not expected that infrastructure required to support current or future LLW disposal options will have an effect on international or transboundary interests.

2. National road and rail infrastructure will be required to transport LLW, it is envisaged that this will not cause any additional stress on the infrastructure given the relatively low volumes of waste.

3. The potential impact of LLW disposal options on infrastructure development is not considered to be significant at this stage. In the context of national radioactivity transfers (500,000 per year)[210,211] and current LLW transports to the LLWR (500-700 annually) an estimate of 8000 transports over the lifecycle of a new nuclear power station (60 years) is small, and the existing infrastructure should be adequate. The infrastructure required to support the construction of new nuclear power will be sufficient to support LLW transports to disposal sites.

Regional/ Local

2. The volumes of LLW generated by operational plants are expected to be low.

3. The majority of LLW from the UK Nuclear Industry is currently disposed of to the LLWR. During operations the estimated quantities of waste from new nuclear power stations would be approximately 2.3% (for 10 x AP1000) of the total UK nuclear LLW inventory by volume[212]. The impact of LLW on local road and rail infrastructure arising from the development of new nuclear power stations is therefore unlikely to be significant.

[210] Health Protection Agency (HPA), Hughes JS *et al*, (2006), Radiological Consequences Resulting from Accidents and Incidents Involving the Transport of Radioactive Materials in the UK, HPA-RPD-034

[211] The movement of spent fuel and radioactive waste is included in this total but the majority of transport packages are associated with medical radioisotopes, radiography source, smoke detectors and other industrial uses

[212] Calculations made using data from Sustainable Development Commission The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006) page 50-53

4. Consideration should be given to localised impacts; the Strategic Environment Assessment supporting the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry[213] recognises that the UK strategy for LLW is unlikely to have a significant effect on transport issues. It also notes that transport is important for local communities, and in the context of local disturbance arising from transport, and perceived risk associated with the transport of radioactive waste, potential localised effects will need to be captured.

5. Utilisation of the rail network for the delivery of LLW packages to the Low Level Waste Repository is preferred and would reduce vehicle movements on regional roads[214]. However, it is noted that not all current nuclear power stations, or potentially suitable sites for new nuclear power stations, are linked to the rail network; some road journeys to the LLWR are therefore anticipated.

6. The location of new nuclear power stations may result in the upgrade of infrastructure such as rail and road links between the power station, the Low Level Waste Repository and any other potential disposal/treatment locations. There is the potential for minor positive effects on off-site, regional infrastructure.

7. Infrastructure may be built to support the disposal of relatively large volumes of VLLW generated during the decommissioning of a new build nuclear power plant. This may have a minor positive impact on infrastructure during the decommissioning phase, but this is unlikely to be significant at a regional level.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects

Mitigation and Monitoring Possibilities

[213] http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-Strategic-Environmental-Assessment-June-2009.pdf page xvii, Objective 10

[214] British Nuclear Group, Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015

• There is the potential for increased pressure on existing infrastructure through the transport of LLW for disposal during operation and decommissioning of new power stations. This could have a minor negative effect on off-site infrastructure in the region but is not considered strategically significant. • Given the relatively small volumes of LLW generated during the operation of new nuclear power stations it is unlikely to have a significant effect on international/national or transboundary infrastructure.	• Transport Management Plan; consideration of rail for movement of LLW • Application of Additionality Guide to assess impact of new nuclear power stations on employment • Application of BPEO/BPM or BAT[215] to minimise waste arisings

[215] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).

LLW: Health and Well-Being

AoS Objective:

to avoid adverse impacts on physical health
to avoid adverse impacts on mental health
to avoid the loss of access and recreational opportunities, their quality and user convenience

Guide questions:

Will it adversely affect the health of local communities through accidental radioactive discharges or exposure to radiation?
Will the storage of radioactive waste result in adverse physical and mental health effects for local communities?
Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?
Will it adversely affect the health of the workforce?
Will it impact upon different vulnerable communities locally?
Will it help to reduce health inequalities?
Will the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities?
Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?

Potential Receptors:

- Local, Regional, European, International Populations

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. UK LLW policy sets out the circumstances where the export (or import) of LLW waste would be permitted. Permissible reasons for exporting LLW are: for the recovery of re-useable materials; or for treatment that will make its subsequent storage and disposal more manageable. In all cases where such processes would add materially to the wastes needing to be disposed of in the country of destination, the presumption should be that they will be returned to the UK, to a timescale agreed by regulators and competent authorities. As such, no significant direct exposure to solid waste consignments is aniticipated.[216].

2. Current estimates of dose from Low Level Waste Repository due to liquid and gaseous discharges are below levels that would have a significant effect on human health[217,218].

3. No credible impact on mental health of populations outside the UK is anticipated.

Regional/ Local

1. Current estimates of radiation doses to local critical groups from direct exposure and liquid and gaseous discharges is below those which will have any significant impact on human health[219,220].

2. Continued Operation Safety Review (COSR) for LLWR indicates no significant increase in radiation exposure to the local community as a result of credible accident scenarios. The Low Level Waste Repository near Drigg in West Cumbria (LLWR) or a successor facility is the likely recipient of most LLW from new nuclear power stations.

3. Increased inventory from new nuclear power stations at LLWR will not have a significant impact on discharges or direct radiation exposure to the public, and the existing regulatory framework will be applicable[221]. LLW will be disposed of to a

[216] DEFRA, Policy for Long-Term Management of Solid Low Level Radioactive Waste in the United Kingdom, DEFRA, DTI, and the Devolved Administrations, (March 2007).
[217] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).
[218] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2000).
[219] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).
[220] United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2000).

suitable disposal facility promptly after it has been generated, and therefore will not be held on site for any significant period of time. Disposal will be at the facility currently operating (LLWR) or a successor facility[222].

4. During operation. the management of increased levels of LLW at new nuclear power stations and at the LLWR or successor facility could potentially lead to increased levels of radiation exposure to the workforce at these locations. However, management of risks will be ALARP and result in acceptable levels of increased stochastic effects[223,224,225.] For example, future doses, up to site closure, at LLWR are estimated in the operational safety case to be approximately 100 µSv per year[226] during the remaining operation of the site[227]. It has been estimated that operating 10 AP1000 reactors for 60 years will generate approximately 80,000m^3 of LLW. The newest Vault at LLWR (Vault 9) will have a capacity of 110,000 m^3 on completion[228]. On this basis new nuclear power stations could require 74% of the volume of a new vault of this size. The estimated future dose at LLWR will not change significantly as a result of LLW from new nuclear power stations and the impact is not considered to be significant[229].

5. Increased consignments of LLW passing through local communities adjacent to disposal sites could potentially have minor adverse effects on collective community well being due to stress caused by increased bulk waste transport through or near to the community. In the case of the LLWR this is partially mitigated by community funding provided through planning agreements between the developer and the local authorities. The current estimate of LLW waste in the UK inventory is 3.47 million m^3

[221] http://www.opsi.gov.uk/acts/acts1993/ukpga_19930012_en_1. The second stage of the Environmental Permitting programme (EPP2) will incorporate the requirements of the Radioactive substances Act 1993
[222]The Energy Bill, http://www.berr.gov.uk/files/file44486.pdf page 68
[223]United Nations, Sources and Effects of Ionizing Radiation (Report to the General Assembly) Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2000).
[224]European Commission, Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996).
[225]Her Majesty Stationary Office (HMSO), Town & Country Planning (Environmental Impact Assessment) (England & Wales) Regulations 1999 (SI 1999 No 293), (1999).
[226] Although below the constraint for annual doses to the public from a single source of 300µSv, the predicted annual dose of 100 µSv is above the "optimisation" level of 20µSv per annum as defined in the Guidance on Requirements for Authorisation. This guidance states that at 20µSv per annum, further reductions in exposure are not required, "*… provided that it is satisfied that the*
Operator is using the best practicable means.
[227] Nuclear Decommissioning Authority (NDA), NDA Strategy Environmental Report, 2005,
http://www.nda.gov.uk/documents/upload/nda_environmental_report_for_consultation_2005.pdf, page 101
[228] British Nuclear Group, Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015
[229] The radionuclide concentration of LLWR from all sources are assumed to be similar

[230,231], Approximately 80,000m^3 (packaged volume) of LLW is estimated to be generated from a programme of 10 AP1000 reactors (10GW over 60 years)[232]. This equates to approximately 8000 individual journeys over the lifetime of the programme[233]. This is a relatively small component of the overall transport burden associated with the new build programme. The Strategic Environment Assessment supporting the NDA's draft UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry [234] notes that transport is important for local communities and in the context of local disturbance arising from transport and perceived risk associated with the transport of radioactive waste potential localised effects will need to be captured.

6. The Sustainable Development Commission concluded that the health impacts of well managed nuclear power facilities are small (particularly in comparison with other energy sources)[235]. This assessment recognises the potential issues associated with waste disposal and decommissioning

Summary of Potential Effects:	Timescale	C	O	D
	Significance	O	O	O
	Likelihood	M	M	M

Significant Effects	**Mitigation and Monitoring Possibilities**

[230] Committee on Radioactive Waste Management (CoRWM), CoRWM's Radioactive Waste and Materials Inventory – July 2005, CoRWM Document No: 1279, (July 2005).
[231] Nuclear Decommissioning Authority (NDA), Radioactive Waste in the UK: A summary of the 2007 Inventory, (2007)
[232] Sustainable Development Commission, The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning http://www.sd-commission.org.uk/publications/downloads/SDC-NuclearPosition-2006.pdf page 50-53
[233] This assumes 1 container per journey
[234] http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-Strategic-Environmental-Assessment-June-2009.pdf
[235] Sustainable Development Commission The Role of Nuclear Power in a Low Carbon Economy, Paper 6: Safety & Security http://www.sd-commission.org.uk/publications/downloads/Nuclear-paper6-SafetyandSecurity.pdf page 35

• No readily identifiable significant impacts on health and well-being from management of LLW from new nuclear power stations. • Increased LLW disposals as a result of new build may have a minor negative effect on collective community well being of local populations, however, these wastes only make up a very small proportion[236] of future LLW arisings in the UK, which are dominated by wastes arising from decommissioning of existing Nuclear Facilities.	• Radioactive Discharge and Environmental Monitoring required by Site Specific Authorisations under RSA93 and reported in RIFE[237] and Pollution Inventory • Improved abatement technologies current guidance in Environment Agency TGN M11 [238] and M12 [239]

[236]Sustainable Development Commission The Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC, (March 2006).page 50-53
[237]FSA, SEPA, EA, EHSNI, Radioactivity in Food and the Environment, 2008, RIFE-14, (2009).
[238]Environment Agency, Technical Guidance Note M12 http://www.environment-agency.gov.uk/static/documents/5-PMHO1299BKHG-e-e.pdf
[239]Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

LLW: Landscape and Cultural Heritage

AoS Objective:

to avoid adverse impacts on the internationally and nationally important features of the historic environment
to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
to avoid adverse impacts on nationally important landscapes
to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness

Guide questions:

Will it adversely affect landscapes within or immediately adjacent to a National Park?
Will it adversely affect landscapes in or immediately adjacent to an AONB or NSA?
Will it adversely affect Heritage Coast or Preferred Conservation Zones?
Will it adversely affect local landscapes/townscapes of value?
Will it affect the levels of tranquillity in an area?
Will it adversely affect the landscape character or distinctiveness?
Will it result in increased levels of light pollution?
Will it adversely affect historic sites of international/national importance and their setting?
Will it adversely affect other historic sites of known value?
Will it adversely affect landscapes of historic importance?

Potential Receptors:

- Landscapes of local to national importance, particularly those affected by the Low Level Waste Repository (LLWR) near Drigg in West Cumbria.

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. The additional LLW generated particularly during the operational and decommissioning phases of new nuclear power stations may place an increase demand on the existing LLWR. An earlier planning application for Vault 9 considered the addition of 7 new LLW vaults, termed vaults 9 – 15. [240] Vault 9 is currently under construction at the LLW Repository. The environmental statement supporting vault 9 construction presents the results of a landscape and visual impact assessment and suggests no substantial impact. This study may not be entirely representative of additional vault development or new national or regional facilities. 2. The cumulative impact of the LLW arisings of new nuclear power stations on cultural heritage is largely associated with the requirement to develop and operate additional disposal and treatment capacity. Such facilities will be subject to the prevailing planning requirements and hence developments will be supported by relevant assessments.
Regional/ Local 1. The emerging NDA UK strategy for Nuclear Industry LLW [241] as well as the Proximity Principle[242] considers the need for consigner communities to take responsibility for their own wastes. Following application of the waste management hierarchy, there is an option of considering disposal of Very LLW (VLLW) at onsite or supply-chain facilities provided the necessary safety assessments can be carried out to the satisfaction of the environmental regulators.. Legacy waste is likely to dominate proposals for siting and developing such facilities and will largely determine capacity requirements. Whilst new nuclear power stations will contribute additional waste volumes, understanding the impact of this on the overall development is not meaningful. Such issues are appropriately considered during the wider planning process which will support each development.

[240] British Nuclear Group, Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015.
[241] http://www.nda.gov.uk/documents/upload/NDA_Final_Strategy_published_7_April_2006.pdf
[242] http://www.defra.gov.uk/environment/radioactivity/waste/pdf/llw-policystatement070326.pdf Page 23

2. LLW interim storage capacity may be developed at new nuclear power station sites. This will be subject to local site-specific assessments to understand the impact on the landscape. In the context of the overall development of a new nuclear power station, and the manner in which LLW is expected to be managed[243], this impact is likely to be negligible.

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	0	0?	0?
Likelihood	M	L	L

Significant Effects

- Legacy waste is likely to dominate the development of additional capacity at the LLWR in West Cumbria or alternative disposal facilities developed in support of the emerging NDA UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry.
- Whilst LLW generated by new nuclear power stations will contribute to the overall LLW inventory this will be small in comparison with legacy LLW requirements. Impact assessments at relevant disposal facilities are expected to consider landscape impact associated with the development.

Mitigation and Monitoring Possibilities

- Completion of appropriate environmental impact studies in support of additional disposal facility planning applications
- Completion of appropriate environmental impact studies in support of LLW waste storage facilities at new nuclear power stations sites

[243] It is anticipated that LLW will be transferred directly to disposal/treatment containers for efficient dispatch.

LLW: Soils, Geology and Land Use

AoS Objective:

to avoid damage to geological resources
to avoid the use of greenfield land and encourage the re-use of brownfield sites
to avoid the contamination of soils and adverse impacts on soil functions

Guide questions:

Will it result in the compaction and erosion of soils?
Will it lead to the removal or alteration of soil structure and function?
Will it lead to the contamination of soils which would affect biodiversity and human health?
Will it compromise the future extraction/ use of geological/ mineral reserves?
Will it result in the loss of agricultural land?
Will it lead to damage to geological SSSIs and other geological sites?
Will it result in the loss of Greenfield land?
Will it adversely affect land under land management agreements?

Potential Receptors:

- Existing Low Level Waste Repository (LLWR) near Drigg in West Cumbria, including potential; requirement to increase capacity to support additional arisings
- Potential National and regional/local LLW facilities
- Local assessments for proposed new nuclear power stations sites identify specific geological receptors

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. A Low Level Waste Repository (LLWR) for the disposal of LLW operates near Drigg in West Cumbria. The LLWR is a key asset in the UK and making best use of this is an essential component of the draft NDA UK strategy for Nuclear Industry LLW[244]. The Consultation on Funded Decommissioning Programme[245] has stated that: "LLW will be disposed of promptly after it has been generated in a suitable facility. Disposal will be at the facility currently operating in West Cumbria or a successor facility". The operation and decommissioning of new nuclear power stations will increase the volume of LLW. Detailed studies considering land use, soils and geology will support further extensions of the LLWR as well as the development of additional disposal capacity elsewhere.

2. It is estimated that building 10 AP1000 reactors will generate approximately 80,000m^3. The newest Vault at LLWR (Vault 9) has a capacity of 110,000 m^3 and a net footprint of approximately 25,000m^2[(246)]. On this basis new nuclear power stations will require 74% of the volume of a new vault, and multiple new vaults are anticipated to manage projected future arisings. This is considered an important impact on soils geology and land use. The recent planning application in support of the construction and operation of Vault 9 was supported by a comprehensive environmental statement addressing such issues[247]. This assessment presented in this statement concluded that the proposed development was considered to have a negligible impact on soils, geology and hydrogeology. The development and use of additional capacity (Vault 9) at the Low Level Waste Repository is principally stimulated by legacy waste, additional capacity will only be permitted pending the outcome of the Environment Safety Case.

[244] http://www.nda.gov.uk/loader.cfm?csModule=security/getfile&pageid=29908 Page 8, 33
[245] Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations http://www.berr.gov.uk/files/file44486.pdf Page 44
[246] British Nuclear Group, Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015
[247] British Nuclear Group, Planning Application for the Construction and Operation of Vault 9 for the Storage of LLW, Environmental Statement Volume 1: Environmental Statement, Report Reference BNGPS/LLW/2/R/MV/015.

Regional/ Local

1. The development of interim storage facilities at new nuclear power station sites may be required. Such developments will be subject to local site proposals and assessment. Power stations typically transfer LLW directly to a LLW disposal container and therefore long term storage on site is unlikely. The Strategic Environment Assessment supporting the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry [248] encourages the development of additional facilities to manage LLW in accordance with the requirements of the waste management hierarchy and additional impacts may be associated with such requirements.

2. The development of alternative disposal options, including regional and/or national disposal facilities for VLLW is addressed in the NDA's LLW strategy. Whilst such initiatives are largely focussed on addressing current liabilities the disposal of operational, and perhaps more significantly, decommissioning wastes associated with new nuclear power stations may stimulate additional disposal capacity requirements. The impact of such developments will be considered in site specific assessments but the likely additional impact is considered minimal due to the radioactivity levels involved.

3. The Local Government Association in their position paper on Low Level Waste recognises the importance of waste planning authorities addressing potential local developments in their MWDF[249]. It is anticipated that local waste planning authorities will review existing plans in the context of new nuclear power stations. Additional detail may be found in site specific appraisals.

4. The development of local storage facilities for LLW at each new nuclear power station sites prior to transfer to treatment and / or disposal facilities may be required. Depending on the site such facilities may utilise brown field or green field land resources. Whilst at a strategic level the impact is likely to be negligible a site specific assessments will be necessary.

	Timescale	C	O	D

[248] http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-Strategic-Environmental-Assessment-June-2009.pdf
[249] Local Government Association Position Paper on Low Level Radioactive Waste, April 2009, http://www.lga.gov.uk/lga/aio/519134

Summary of Significant Strategic Effects:	Significance	O	O	O
	Likelihood	M	L	L

Significant Effects	Mitigation and Monitoring Possibilities
• LLW waste management at new nuclear power station sites has the potential for local impacts on soils and land use due to the development of interim storage facilities. These developments would be subject to site-specific assessments and it is not considered that these will give rise to any strategically significant effects. • LLW from new nuclear power stations will require disposal at the LLWR or successor facility. However, legacy waste issues will dominate and the development of such facilities will be more addressed through specific environmental assessments for these facilities.	• Local environmental assessments in support of development of additional disposal capacity at Low Level Waste Repository and other potential disposal sites

LLW: Water Quality and Resources

AoS Objective:

to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology)
to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives
to avoid adverse impacts on the supply of water resources
to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive 2000/60/EC objectives

Guide questions:

Will it result in the increased sedimentation of watercourses?
Will it adversely affect channel geomorphology?
Will hydrology and flow regimes be adversely affected by water abstraction?
Will it result in demand for higher defence standards that will impact on coastal processes?
Will it result in the sediment loading of watercourses?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it affect designated Shellfish Waters?
Will it affect Freshwater Fish Directive sites?
Will it increase turbidity in watercourse?
Will it increase the temperature of watercourses?
Will it adversely affect water supply as a result of abstraction?
Will it significantly increase demand for water?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local water resources both surface water and groundwater
- National and International coastal environment identified in site specific reports
- Sensitive marine and freshwater habitats, identified in site specific reports

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Coastal flooding and general disturbance of the Low Level Waste Repository site could lead to contamination and potentially slightly elevated levels of radioactivity in the Irish Sea. Work being undertaken on LLWR's Environmental Safety Case has indicated that the LLWR is likely to be affected by coastal erosion over the very long term (750 to 1,000 years)[250], this could potentially result in radioactive waste reaching the beach if increased flood defences were not considered. Coastal sea level mapping and sea defences will aid in the short term protection of the site. Site protection from flooding will be a priority irrespective of the new build programme.

Regional/ Local

1. The initial construction of a facility at a new nuclear power station site, as with any building project, will disturb the surface soils. If this were to occur on previously contaminated soils this could potentially result in a release of contaminants into the local watercourses. Site surveys and sample analysis will provide data to ensure the sites construction could be managed using BPM and BPEO/BPM or BAT[251] appropriately to minimise any potential impact to the local environment

[250] Low Level Waste Repository (LLWR), Developing the Repository's Environmental Safety Case, Richard Cummings Presentation at the LLWR 2009 Forum, 22nd April 2009. http://www.llwrsite.com/UserFiles/File/LowLevelWaste2009/2_4-RichardCummings-LLW2009.pdf , (2009).
[251] The EA is proposing to replace BPM / BPEO in England and Wales with Best Available Techniques (BAT).

2. Additional new nuclear power stations will result in an increase in LLW. This may require the expansion of the LLWR or alternative disposal or treatment facilities. A number of nuclear facilities including the LLWR have recently identified an issue regarding the release of Tritium into a local groundwater source. In 2004, a low concentration of tritium was found in groundwater off the site, and was thought to be due to the leaching of tritium from the old landfill part of the site. The completion of the construction of the curtain wall around the landfill has resulted in reducing such emissions. The development of more establishments for disposal of LLW would result in an increased risk of emissions of radioactive substances into the environment and perhaps into local watercourses, although changes made in the design of LLW storage, such as the use of vaults, is likely to mitigate this risk.

3. Under the Nuclear Installations Act 1965 a safety case will be required. As part of this an investigation into the release of radionuclides into the environment is required. This takes into account affects to the local marine and freshwater environment as a flooding event is a foreseeable accident. Monitoring of these environments including turbidity tests and water flow should also be performed as part of the Radioactive Substances Authorisation held by the site.

4. There is the potential for LLW to exhibit other hazardous properties other than that of radioactivity. These pollutants also have the potential to affect local watercourses. The Water Framework Directive[252] applies to all surface water bodies, including lakes, streams, rivers, estuaries and coastal waters up to one mile from low water, and to artificial waters such as canals. It also applies to groundwater. Any LLW facility will have to consider a number of Planning Policy Statements and demonstrate how these requirements will be met before planning permission is granted. PPS 11 'Regional Spatial Strategies' (RSS) in England[253], Annex A 'Policy and guidance on topics to be covered in a RSS' states that the WFD "Requires all inland and coastal waters to reach 'good status' by 2015. It will do this by establishing a river basin district structure within which demanding environmental objectives will be set, including ecological targets for surface waters, in particular 'Duty to have regard to river basin management plans and supplementary plans'". PPS23 'Planning and Pollution Control[254]' has an annex on pollution control, air and water quality and advises planning authorities to take account of the WFD now. The application of the PPS's and their enforcement by the Local Planning Authorities should ensure that any potentially significant effects are assessed before a facility is granted planning approval. Permits will be granted by the EA under the Environmental Permitting Regulations 2007 to facilities that may release any hazardous material into the environment. These requirements will apply to the Low Level Waste Repository and new

[252] http://ec.europa.eu/environment/water/water-framework/index_en.html
[253] http://www.communities.gov.uk/documents/planningandbuilding/pdf/147423.pdf
[254] http://www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement23

disposal facilities. The specific impact of LLW arising from new nuclear power stations will be minor in the context of legacy wastes.

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	O	O	O
Likelihood	L	L	L

Significant Effects

- Construction on brownfield land that may have previously sited former nuclear establishments may have contaminated ground. Any construction on the land will require careful management to ensure release of contamination into the aquatic environment does not occur.
- There is the potential for LLW to exhibit other hazardous properties other than that of radioactivity. These pollutants also have the potential to affect local watercourses and will require careful assessment and management.

Mitigation and Monitoring Possibilities

- Identification of future issues within the LLWR's Environmental Safety Case.
- An EIA should identify any environments including groundwater that may be affected by the presence of a LLW facility. Any detrimental affects that may become apparent can then be required to be investigated and their risks assessed. Mitigation techniques can then be proposed to minimise or prevent these effects from occurring (Environment Agency TGN M12[255])
- Monitoring of the local environment is a requirement under Environmental Permitting Regulations 2010 for large Nuclear Licensed sites. Any effect to the local environment is therefore monitored,

[255] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

	recorded, and controlled under the facilities EPR 10 authorisation

LLW: Flood Risk

AoS Objective:

to avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible

Guide questions:

Can the higher defence standards be achieved without compromising habitat quality and sediment transport?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local population from additional risk of flooding due to increased surface runoff

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. There is potential for flooding at any facility located close to the coast as UK sea level is predicted to rise due to climate change. LLWR is located between 10 and 20m Above Ordnance Datum (AOD) alongside the Cumbrian coastline and is believed to be protected from coastal flooding and sea level rises by a 10 – 15m headland and dune spit [256].

2. Coastal flooding and general disturbance of the Low Level Waste Repository site could lead to contamination and potentially slightly elevated levels of radioactivity in the Irish Sea. Work being undertaken on LLWR's Environmental Safety Case has

[256] NDA, LLW Strategic Environmental Assessment, http://www.nda.gov.uk/documents/upload/UK-Nuclear-LLW-Strategy-Site-Specific-Baselines-Part-I-England-June-2009.pdf page 41

indicated that the LLWR facility is likely to be affected by coastal erosion in 750 to 1,000 years[257], this could result in radioactive waste reaching the beach, even if current sea level remains. Coastal sea level mapping and sea defences will aid in the short term protection of the site. Site protection from flooding will be a priority irrespective of the new build programme.

Regional/ Local

1. Solid LLW disposal facilities such as LLWR may be affected by flooding including coastal flooding; the effects will have to be assessed on a case by case basis. The evidence for coastal change along the stretch of coast that includes the LLWR site is of progressive, but slow recession taking place within a stable overall coastline configuration. In the longer term, probably greater than 300 years, there is risk of disruption of the LLWR site by coastal erosion. The potential long term stability of any new waste disposal facility, against the risk of flooding, will require detailed assessment, although this does not directly impact the development of new nuclear power stations (although the issues are associated). The impact of flooding specific to on-site interim storage of LLW at a new nuclear power stations is considered to be insignificant in the context of the larger development (which will require detailed flood risk assessment before development).

2. The introduction of a new nuclear facility could potentially affect the permeability of the ground and could increase surface runoff, which has the potential to increase the risk of flooding to the surrounding area. A Flood Risk Assessment (FRA) would identify any potential problems with increase surface drainage caused from the introduction of a new facility and mitigation techniques will be required to be applied before planning permission is granted. A number of currently operating nuclear sites have this issue and have built dedicated drainage systems in place to deal specifically with surface runoff. This would particularly affect temporary surface storage of LLW at new nuclear power station sites and the LLWR.

3. Severe flooding of Solid LLW facilities could potentially lead to low level contamination of local surface water stores and groundwater and potentially effect local marine and freshwater habitats. It is therefore important to choose sites location with this

[257] Low Level Waste Repository (LLWR), Developing the Repository's Environmental Safety Case, Richard Cummings Presentation at the LLWR 2009 Forum, 22nd April 2009. http://www.llwrsite.com/UserFiles/File/LowLevelWaste2009/2_4-RichardCummings-LLW2009.pdf , (2009).

in mind. It is currently governmental policy for any new developments to submit a Flood Risk Assessment (FRA) alongside any planning application as stated in paragraphs 10-13 of Planning Policy Statement 25[258]. This process ensures that all aspects of flood risk are assessed prior to construction. An FRA takes into account the facilities size, design, building use and construction material, as well as all aspects of drainage, local coastal and fluvial systems and investigates any alternative mitigation options.

4. Flooding of a site which is storing solid LLW could potentially lead to contamination of local marine and freshwater habitats. An Environmental Impact Assessment is required to be submitted as part of the planning procedure under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999[259]. The EIA should investigate all possible effects the facility may pose to the local environment and habitats.

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	O	O	O
Likelihood	L	L	L

Significant Effects

- Insignificant risk of flooding specific to interim storage of LLW on-site at a new nuclear power station during all phases (construction, operation, decommissioning), as this will be in the context of flood defences that are required for the whole power station.

Mitigation and Monitoring Possibilities

- Changes in construction design/location for new developments as required in a FRA (i.e. no developments on or near a floodplain) will minimise the potential possibility of flooding of a site and their effects should flooding occur

[258] http://www.communities.gov.uk/documents/planningandbuilding/pdf/324694.pdf
[259] Her Majesty Stationary Office (HMSO), Town & Country Planning (Environmental Impact Assessment) (England & Wales) Regulations 1999 (SI 1999 No 293), (1999).

Section 6 Appraisal Matrices: Gaseous and Liquid Radioactive Discharges

Notes on Appraisal approach

11. The discussion of potential effects and mitigation possibilities includes the effects of waste management at nuclear power station sites, transport offsite and effects at the site for final disposal of the waste where applicable.
12. The Summary of potential effects for each topic includes the effects of waste management at nuclear power station sites and transport offsite only.
13. The Summary of potential effects is carried to the summary tables for each waste type that are presented in Section 6 of the Main AoS.

Key to Appraisal				
Key to appraisal of Strategic Effects:			**Abbreviations:**	
Significance		**Category of effect**	**Timescale**	
++	Major Significant	Development actively encouraged as it would resolve an existing sustainability problem. Effect considered to be of national/ international significance.	C	Construction stage
+	Minor Significant	No Sustainability constraints and development acceptable. Effect considered to be of national/ international significance.	O	Operation stage
0	No significance	Neutral effect	D	Decommissioning stage
-	Minor Significant	Potential sustainability issues; mitigation and / or negotiation possible. Effect considered to be of national/ international significance.	**Likelihood**	
--	Major Significant	Development problematical because of known sustainability issues; mitigation or negotiation difficult and/ or expensive. Effect considered to be of national/ international significance.	H	High Likelihood
?	Uncertainty	Where the significance of an effect is particularly uncertain, for example because insufficient information is available at the plan stage to fully appraise the effects of the development or the potential for successful mitigation, the significance category is qualified by the addition of '?'.	M	Medium Likelihood
			L	Low Likelihood

Gaseous and Liquid Radioactive Discharges: Air Quality

AoS Objective:

To avoid adverse impacts on air quality

Guide questions:

Will it result in the release of radionuclides that may adversely affect human health or biodiversity?
Will it contribute to an increase in the number or expansion of Air Quality Management Areas (AQMAs)?

Potential Receptors:

- Local populations close to new nuclear power station sites
- Regional and National Populations; cumulative impacts associated with new nuclear power stations
- Sensitive habitats identified in site specific reports (new nuclear power station sites)

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. An Article 37 submission[260] to the European Commission would be required plans for any new facility or a change to existing facilities where the risks increase or the restrictions on emissions are reduced. This submission must provide enough data to make it possible for the Commission to determine whether the implementation of such plans is liable to result unacceptable levels of radioactive contamination of the water, soil or airspace of another Member state. The Commission is required to

[260] If an EU Member State alters the way in which it plans to handle or dispose of radioactive materials that results in a reduction on restrictions on discharges, increases the levels of risk, or if it plans to build a new facility that handles, disposes or processes radioactive materials it must make a submission to the Commission seeking an opinion on the proposals.

deliver its opinion, having consulted its group of experts, within six months,. Until the opinion of the Commission has been received, an authorisation to carry out the work cannot be given. The details of how this system operates are set out in Commission Recommendation 1999/829/Euratom of 6 December 1999 on the application of Article 37 of the Euratom Treaty[261].

2. Council Directive 96/29/Euratom established basic safety standards[262] for doses to people, including members of the public. This sets the effective dose limit for members of the public at 1mSv in a year. Cm 2919[263] establishes UK policy which restricts the dose to members of the public to a maximum of 0.3 mSv/y from a single source (eg. a new nuclear installation). This complements rather than replaces the primary dose limit of 1 mSv/y. The current regulatory framework, which includes the requirement for an EPR 10 authorisation for all new and existing nuclear power stations and adherence to the dose constraints detailed in The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000[264], will minimise discharges to air to levels that are as low as is reasonably practicable (ALARP).

3. The EA has concluded that the annual radiation impact on people of the AP 1000 reactor and EPR reactor designs, (both of which are being considered as part of the Generic Design Assessment (GDA) for new nuclear power stations), would be below the UK constraint for any single source[265]. The EA has also concluded that the annual radiation impact on people would be below the UK constraint for any single source[266].

4. While controlled directly under RSA93 Authorisations and the Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000[267], the UK is also committed to making its contribution to the delivery of the OSAPR Convention on the Protection of the marine environment of the North-East Atlantic. Through the publication of the UK Strategy on Radioactive

[261] European Commission Recommendation 1999/829/Euratom: http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/99829_en.pdf
[262] European Commission Council Directive 96/29/Euratom of 13 May 1996 laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (2006).
[263] Her Majesty Stationary Office (HMSO), Command 2919 Review of Radioactive Waste Management Policy Final Conclusions July 1995, (1995).
[264] The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction
[265] Environment Agency, Generic Design Assessment of New Nuclear Power Plant Designs, Statement of findings following preliminary assessment of submission by: Westinghouse Electric Company LLC for their AP1000 design, (March 2008a). http://www.environment-agency.gov.uk/static/documents/Business/AP1000.pdf page 3
[266] Environment Agency, Generic Design Assessment of New Nuclear Power Plant Designs summary document, Statement of findings following preliminary assessment of submission by: AREVA NP SAS and Electricité de France SA for their UK design, (March 2008b). http://www.hse.gov.uk/newreactors/reports/arevasummary.pdf page 1
[267] The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000.

Discharges[268] the UK has set out its plans for the continuous reduction in radioactive discharges. This includes the reduction of discharges to air, soil and water as all have the potential capability of reaching the sea and adding to the existing background levels of radioactivity.

Regional/ Local

1. No gaseous or liquid radioactive discharges are expected during construction.
2. The UK has an established regulatory regime supported by independent regulatory bodies; the Nuclear Installations Inspectorate (NII) and Environment Agency (EA). All facilities, including: nuclear reactor sites, interim storage facilities and a GDF for higher activity wastes will be subject to comprehensive regulation by the NII and impacts on air quality will be subject to appropriate preventative and mitigation measures.
3. Radioactive discharges to air will arise from an operational nuclear power station from the following sources: gaseous radioactive emissions from the coolant circuits and discharges from the main buildings. Radioactive discharges to air from new nuclear power station sites will be authorised by the Environment Agency under EPR 10 to ensure they are within acceptable limits. Releases are required to be As Low As Reasonably Achievable (ALARA) and managed in accordance with documented arrangements approved by the EA; in accordance with the updated regulatory environmental principles[269] and guidance[270] issued by the Environment Agency. The concept of Best Available Techniques (BAT) will apply to regulation under the EPR 10 to minimise all such discharges. The Environment Agency[271] has reported a steady decrease in discharges to air since 2000 and that radiation doses to critical groups of adults and children living around nuclear sites remain below the public dose limit of 1mSv a year.
4. For all new build nuclear power stations DECC has made the policy assumption that they will not require the spent fuel to be

[268] UK Strategy on Radioactive Discharges (http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/government/discharges/strategy/strategy.aspx)
[269] Environment Agency, Radioactive Substances Regulation: Environmental Principles, 2009, http//environment-agency.gov.uk/business/sectors/111010.aspx
[270] Environment Agency, Radioactive Substances Regulation: Assessment of Best Available Techniques (BAT), 2009, http//environment-agency.gov.uk/business/sectors/111010.aspx
[271] Environment Agency, Nuclear Sector Plan, 2007 Environmental Performance Report, (January 2009), http://publications.environment-agency.gov.uk/pdf/GEHO1105BJVE-e-e.pdf

reprocessed. Therefore the discharge levels from new build reactors will be lower than those for existing plant. That said, discharges from new nuclear power station sites will be subject to comprehensive monitoring arrangements to ensure compliance with discharge limits agreed as part any EC Article 37[272] (Euratom) opinion and EPR 10 authorisation . Such arrangements may include environmental sampling of receptors local to new nuclear power station sites.

5. Discharges to air and water of radioactive materials are possible during decommissioning of nuclear power stations and interim storage facilities. Such activity will be subject to the prevailing regulatory framework, including application of the principles of ALARA and BAT to mimimise releases and wastes.

6. Discharges to air from higher activity wastes disposed of at an operational GDF may affect air quality, but such impacts will be minimised. The fuel structure and associated containment and encapsulation systems used during interim storage and disposal will slow down the migration of radionuclides so that emissions of even the most mobile radionuclides will be very low. This, combined with the low radio-toxicity of these radionuclides means that their contribution to dose during disposal in a GDF will be low[273].

7. The new nuclear build reactors may comprise of higher concentrations of readily releasable radionuclides from the volatile fission products and this should be taken into account in developing a GDF. Studies completed in support of the EPR[274] have indicated that there is suitable shielding available to enable safe handling and confirm that there is existing engineered barrier technology available to ensure safe disposal of waste including readily releasable radionuclides in spent fuel.

[272] If an EU Member State alters the way in which it plans to handle or dispose of radioactive materials that results in a reduction on restrictions on discharges, increases the levels of risk, or if it plans to build a new facility that handles, disposes or processes radioactive materials must make a submission to the Commission seeking an opinion on the proposals

[273] Generic Repository Studies Generic post-closure Performance Assessment United Kingdom Nirex Limited Nirex Report no. N/080 July 2003 http://130.237.70.51/reports/Nirex%20Report%20N080%20-%20Generic%20Repository%20Studies%20%20Generic%20Post-closure%20Performance%20Assessment%20-%20Main%20ReportAppendices%20Nirex-PGA3%20_v1.pdf

[274] Health and Safety Executive, Reactor Designs, www.hsfor exampleov.uk/reactors/reactordesigns.htm, accessed 16/03/2009 (2009).

Summary of Potential Effects:	Timescale	C	O	D
	Significance	0	0	0
	Likelihood	-	-	-

Significant Effects

- No significant effects are expected on air quality from controlled radioactive discharges because of the safeguards provided by the regulatory regime.

Mitigation and Monitoring Possibilities

- No further mitigation is required as no significant effects have been identified but the EA authorisation for discharges from new nuclear power station sites and the environmental monitoring and sampling regime at new nuclear power stations will contribute to the achievement and maintenance of this outcome.
- Application of ALARA and BAT at new nuclear power station sites will also help to minimise releases.

Gaseous and Liquid Radioactive Discharges: Biodiversity

AoS Objective:

to avoid adverse impacts on the integrity of wildlife sites of international and national importance
to avoid adverse impacts on valuable ecological networks and ecosystem functionality
to avoid adverse impacts on Priority Habitats and Species including European Protected Species

Guide questions:

Will it result in the loss of habitats of international/national importance?
Will it affect other statutory or non-statutory wildlife sites?
Will it result in harm to internationally or nationally important or protected species?
Will it adversely affect the achievement of favourable conservation status for internationally and nationally important wildlife sites?
Will it affect the structure and function/ecosystem processes that are essential to restoring, securing and/or maintaining favourable condition of a feature or a site?
Will the proposal enable the BAP targets for maintenance, restoration and expansion to be met?
Will the proposal result in changes to coastal evolution that is otherwise needed to sustain coastal habitats?
Will it result in the release of harmful substances, for example oil, fuel and other pollution into water bodies which could affect aquatic ecosystems?
Will it result in the accidental migration of radionuclides which could harm aquatic or terrestrial ecosystems?
Will it result in changes to stream hydrology and morphology that could affect aquatic or terrestrial ecosystems?
Will it result in thermal discharges that could adversely affect aquatic ecosystems?
Will it result in soil contamination that could damage aquatic or terrestrial ecosystems?

Potential Receptors:
• Local, Regional, European, International habitats
Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. Gaseous and liquid radioactive discharges may transfer through the global environment. Controls to limit the effects locally, nationally and within Europe shall serve to limit the effects globally. The prevailing regulatory framework will control the effect of gaseous and liquid radioactive discharges on Habitats in EU member States. 2. Article 13 of the Basic Safety Standards Directive limits radiation doses to human populations of EU member states from radioactive discharges to 1mSv per year; this will also limit radiation doses to flora and fauna. 3. Work is ongoing within the EU on methodologies to assess the impact of ionising radiation on biota. They include: • ERICA (Environmental Risk from Ionising Contaminants: Assessment and Management) will provide an integrated approach to scientific, managerial and societal issues concerned with the environmental effects of contaminants emitting ionising radiation, with emphasis on biota and ecosystems[275]; • FASSET (Framework for assessment of environmental impact of ionising radiation in major European ecosystems) includes: source characterisation; description of seven major European ecosystems; selection of a number of reference organisms on the basis of prior ecosystem and exposure analysis; environmental transfer analysis; dosimetric considerations and effects analysis[276]; • PROTECT (Protection of the Environment from Ionising Radiation in a Regulatory Context) will evaluate the practicability and relative merits of different approaches to protection of the environment from ionising radiation and compare these with methods used for non-radioactive contaminants[277].

[275] http://www.ceh.ac.uk/protect/ERICAdeliverables.html
[276] http://www.ceh.ac.uk/protect/FASSETdeliverables.html
[277] http://www.ceh.ac.uk/protect/EPICdeliverables.html

Regional/ Local

1. Construction of facilities to manage gaseous and liquid effluent, in particular pipelines for liquid discharges may have a negative impact due to disruption of habitat.

2. Radioactive discharges resulting from new nuclear reactor operations will be controlled by Authorisations issued by the Environment Agency under the Environmental Permitting Regulations 2010. This ensures that doses from all sources to members of the public are less than 1mSv per annum; this will also tend to limit radiation doses to flora and fauna. As the annual public doses received from the existing water cooled power station at Sizewell B, are <0.005mSv[278] it is highly unlikely that there will be any measurable effects on biodiversity as a result of radioactive discharges from new build Pressurised Water Reactors.

3. There is the potential for long-term positive effects on biodiversity at nuclear power station sites because security and safety controls will reduce human access to the sites and therefore disturbance, although this benefit only indirectly linked to any radioactive discharges. The benefit of reduced disturbance has been evident on existing Nuclear Licensed Sites in the UK[279].

Summary of Potential Effects:

Timescale	C	O	D
Significance	-	+?	+?
Likelihood	M	H	M

Significant Effects

- There are no significant radiological effects.
- Minor negative effect during construction of waste treatment facilities and pipelines because of disruption of habitat.
- Minor positive effect during operation and decommissioning from exclusion of

Mitigation and Monitoring Possibilities

- Ecological surveys and construction management plans to minimise effects of construction

[278] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008), http://www.cefas.co.uk/publications/rife/rife13.pdf
[279] Environment Agency (EA)The Environment Agency's Assessment of BNFL's 2002 Environmental Safety Cases for the Low-Level Radioactive Waste Repository at Drigg. NWAT/Drigg/05/001 (Version: 1.0) (2005).

public from areas where discharges are generated.	

Gaseous and Liquid Radioactive Discharges: Climate change

AoS Objective:

to minimise greenhouse gas emissions

Guide questions:

Will it take account of future effects and risks of climate change, for example sea level rise?
Will future changes in weather patterns be considered?
Will it result in increased vehicular emissions (particularly carbon dioxide)?
Will the development result in an overall reduction in greenhouse gas emissions over its life time resulting from changes in:

- Transport of people and goods
- Scope, form and methods of asset construction, maintenance and demolition
- Waste recycling and disposal
- Land management practices
- Other secondary activities in the wider local and national economy

Note: Adaptation to climate change is discussed in other relevant topic appraisals, for example biodiversity, water, flood risk.

Potential Receptors:

- Human population and environment at all geographical scales.

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Radioactive gaseous and liquid radioactive discharges will not impact climate change directly.

2. Indirect impacts may arise from the generation and use of power for the operation of ventilation plant, pumps and other plant and equipment essential to manage gaseous and liquid radioactive discharges. However, because of the small scale of these activities in the context of the other operations at a power station, the indirect effects on climate change are not considered to be significant.

Regional/ Local

1. Gaseous and liquid radioactive discharges will not impact climate change directly. Indirect effects are not considered to be significant for the reasons given above.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	H	H	H

Significant Effects

- No significant effects on climate change arising from gaseous and liquid radioactive discharges

Mitigation and Monitoring Possibilities

- Energy use for management of gaseous and liquid discharges monitored under Environment Agency authorisations.

Gaseous and Liquid Radioactive Discharges: Communities: Population, Employment and Viability

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it create significant pressure on local / regional / National Radioactive Waste Management Facilities
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Populations local to new nuclear power station sites

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Radioactive gaseous and liquid radioactive discharges will not have any significant international, national or transboundary effects on communities: population, employment and viability.

Regional/ Local

1. Additional minor employment opportunities may be created during construction of discharge infrastructure and monitoring / sampling equipment installation, calibration and commissioning.

2. Additional employment opportunities may be created at the new nuclear power station site to manage and verify site multi-media discharge authorisation issued underEPR 10.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	L

Significant Effects

- Additional employment opportunities to manage and verify new nuclear power station site multi-media authorisations. However, these are small in relation to those associated with other waste streams, and other aspects of new nuclear power stations overall and are not considered significant.

Mitigation and Monitoring Possibilities

- n/a

Gaseous and Liquid Radioactive Discharges: Communities: Supporting Infrastructure

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Populations local to new nuclear power station sites

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. No International, National and Transboundary effects identified.

Regional/ Local

1. No direct effects on supporting infrastructure associated with gaseous and liquid radioactive discharges identified.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects

- No significant effects identified from gaseous and liquid radioactive discharges.

Mitigation and Monitoring Possibilities

- n/a

Gaseous and Liquid Radioactive Discharges: Health and Well-Being

AoS Objective:

to avoid adverse impacts on physical health
to avoid adverse impacts on mental health
to avoid the loss of access and recreational opportunities, their quality and user convenience

Guide questions:

Will it adversely affect the health of local communities through accidental radioactive discharges or exposure to radiation?
Will the storage of radioactive waste result in adverse physical and mental health effects for local communities?
Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?
Will it adversely affect the health of the workforce?
Will it impact upon different vulnerable communities locally?
Will it help to reduce health inequalities?
Will the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities?
Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?

Potential Receptors:

- Local, Regional, European, International Populations

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Gaseous and liquid radioactive discharges may transfer through the global environment. Controls to limit the effects locally, nationally and within Europe shall serve to limit the effects globally. The UK has an established regulatory regime supported by independent regulatory bodies; the Nuclear Installations Inspectorate (NII) and Environment Agency (EA). Gaseous and liquid radioactive discharges from new nuclear power station sites will be authorised by the Environment Agency under EPR 10 to

ensure they are within acceptable limits. These discharges will be subject to comprehensive monitoring arrangements to ensure compliance with the discharge limits set as part of the EPR 10 authorisation.

2. The Basic Safety Standards Directive limits radiation doses to human populations of EU member states from radioactive discharges from all artificial sources to 1mSv per year. The annual public doses received by the most exposed individual in the UK from the existing nuclear power station at Sizewell B, are very much lower than this limit (see Regional/Local Section below). It is anticipated that radiation doses received in Member States will have no significant health implications.

3. Current liquid and gaseous discharges from Low Level Waste Repository (LLWR) will not be significantly increased as a result of disposals from new nuclear power stations because of the small additional quantities of LLW estimated to be generated by a programme of new nuclear power stations. As a result the effects to populations of European Member States is not expected to be significantly affected.. Existing and new liquid and gaseous discharge limits from LLWR are authorised by the Environment Agency.

Regional/ Local

1. Gaseous and liquid radioactive discharges will arise during the life cycle of nuclear power stations. The main sources of controlled discharges at power station sites are expected to be reactor operation (including from the management of radioactive wastes), interim storage of ILW and spent fuel and from reactor decommissioning. For all new build nuclear power stations DECC has made the policy assumption that they will not require the spent fuel to be reprocessed. Therefore the discharge levels from new build reactors will be lower than those for existing plant. However, gaseous and liquid discharges will continue to be regulated by the Environment Agency under EPR 10 and will require site operators to demonstrate BAT, and ALARP measures are in place. The conditions placed upon operators within these Authorisations will ensure that the total annual dose to the public from all operations will not exceed a dose limit of 1mSv.

2. In the Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000[280] and Cm 2919[281] the UK Government states that if exposures are calculated to be below 0.02mSv/y (broadly equivalent to less than 1 in a million annual chance of death), the regulators should not seek to secure further reductions in the exposure to members of the public. Current estimates of radiation doses to the most exposed individuals in the vicinity of the existing water cooled power station at Sizewell B from liquid and gaseous discharges are <0.005mSv per annum[282]. Exposures at this level are very much lower than those which will have any significant impact on human health[283].

3. The Sustainable Development Commission concluded that the health impacts of well managed nuclear power facilities are small (particularly in comparison with other energy sources)[284], even allowing for the potential issues associated with waste disposal and decommissioning.

[280] The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000.
[281] Her Majesty Stationary Office (HMSO) Command 2919 Review of Radioactive Waste Management Policy Final Conclusions July 1995, (1995).
[282] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), (2008), Radioactivity in Food and the Environment, 2007, RIFE-13. http://www.cefas.co.uk/publications/rife/rife13.pdf
[283] Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2006), http://www.unscear.org/
[284] Sustainable Development Commission the Role of Nuclear Power in a Low Carbon Economy, Paper 5: Waste and Decommissioning, An evidence based report by the Sustainable Development Commission with Contributions from Nirex, AMEC and NNC (March 2006). http://www.sd-commission.org.uk/publications/downloads/SDC-NuclearPosition-2006.pdf page 16

4. Current liquid and gaseous discharges from LLWR to UK and local populations will not be significantly increased as a result of disposals from new nuclear power stations[285].

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects

- Operation and decommissioning of new nuclear power stations (including management of radioactive waste) will result in controlled gaseous and liquid radioactive discharges. That said, while the overall levels of discharges are projected to fall there will be periods (due to decommissioning work) where the discharges will increase for a short period to dispose of legacy waste.
- However, provided these are within authorised limits there should not be any negative effect on the physical well-being of either the workforce or the public in the vicinity of these sites.

Mitigation and Monitoring Possibilities

- Radioactive Discharge and Environmental Monitoring required by Site Specific Authorisations under EPR 10 and reported in CEFAS[286] and Pollution Inventory.

[285] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008).
[286] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008). http://www.cefas.co.uk/publications/rife/rife13.pdf

Gaseous and Liquid Radioactive Discharges: Landscape and Cultural Heritage

AoS Objective:

to avoid adverse impacts on the internationally and nationally important features of the historic environment
to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
to avoid adverse impacts on nationally important landscapes
to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness

Guide questions:

Will it adversely affect landscapes within or immediately adjacent to a National Park?
Will it adversely affect landscapes in or immediately adjacent to an AONB or NSA?
Will it adversely affect Heritage Coast or Preferred Conservation Zones?
Will it adversely affect local landscapes/townscapes of value?
Will it affect the levels of tranquillity in an area?
Will it adversely affect the landscape character or distinctiveness?
Will it result in increased levels of light pollution?
Will it adversely affect historic sites of international/national importance and their setting?
Will it adversely affect other historic sites of known value?
Will it adversely affect landscapes of historic importance?

Potential Receptors:

- Landscape and Cultural Heritage amenity associated with new nuclear power station sites and GDF

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. The additional facilities for treatment and discharge of radioactive wastes are of small size in relation to the major structures comprising nuclear power stations. There can also be some flexibility as to where the facilities are located within the site so as to avoid or mitigate effects on landscape and cultural heritage interests. Therefore, it is not expected that significant effects on landscape or cultural heritage interests of international or national importance are likely to be produced by the arrangements for dealing with gaseous and liquid radioactive discharges, although this would need to be assessed for each site at the detailed planning stage.

Regional/ Local

1. As noted above, the additional facilities for treatment and discharge of radioactive wastes are minor relative to other structures comprising nuclear power stations. Nevertheless, emission stacks associated with authorised discharge points may have a negative effect on the local landscape. Such issues would be considered in site specific assessments, including EIA, where appropriate mitigation could be identified. However, landscape and cultural heritage impacts will be dominated by the wider site development.

2. No significant effects associated with radioactive discharges are expected during construction.

3. Effects on landscape and cultural heritage are not expected during decommissioning.

Timescale	C	O	D
Significance	0	-?	0?

Summary of Potential Effects:	Likelihood	M	M	M
Significant Effects • Emission stacks associated with authorised discharge points may locally have a negative effect on landscape and cultural heritage although effects will be dominated by the wider site development and their significance will depend on the landscape and cultural heritage settings of the site	**Mitigation and Monitoring Possibilities** • Site specific EIA and appropriate mitigation			

Gaseous and Liquid Radioactive Discharges: Soils, Geology and Land Use

AoS Objective:

to avoid damage to geological resources
to avoid the use of greenfield land and encourage the re-use of brownfield sites
to avoid the contamination of soils and adverse impacts on soil functions

Guide questions:

Will it result in the compaction and erosion of soils?
Will it lead to the removal or alteration of soil structure and function?
Will it lead to the contamination of soils which would affect biodiversity and human health?
Will it compromise the future extraction/ use of geological/ mineral reserves?
Will it result in the loss of agricultural land?
Will it lead to damage to geological SSSIs and other geological sites?
Will it result in the loss of Greenfield land?
Will it adversely affect land under land management agreements?

Potential Receptors:

- National and international environmental receptors
- Environment near new nuclear power station sites

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Gaseous and liquid radioactive discharges could produce effects on soils and geology at this scale through transport of discharged radioactive contaminants via air or water and subsequent deposition. However, the appraisal of the effects of such

discharges from new nuclear power stations on air and water quality is that provided discharges are within permitted limits, no significant adverse effects on air or water quality will arise at this scale. Given that discharges would be at these low levels, it is not considered likely that significant effects will occur to soils and geology.

2. Proposals for new nuclear power stations will be subject to an Article 37 submission[287] to the European Commission which is required where an EU Member State alters the way in which it plans to handle or dispose of radioactive materials that results in a reduction on restrictions on discharges, increases the levels of risk, or plans to build a new facility that handles, disposes or processes radioactive materials. . This submission must provide enough data to make it possible to determine whether the implementation of such plans is liable to result in the radioactive contamination of the water, soil or airspace of another Member state. The Commission is required to deliver its opinion within six months, after consulting the group of experts. Until the opinion of the Commission has been received an authorisation to carry out the work cannot be given. The details of how this system operates are set out in Commission Recommendation 1999/829/Euratom of 6 December 1999 on the application of Article 37 of the Euratom Treaty[288].

1. While controlled directly under EPR 10 Authorisations and the Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000[289], the UK is also committed to making its contribution to the delivery of the OSPAR Convention on the Protection of the marine environment of the North-East Atlantic. Through the publication of the UK Strategy on Radioactive Discharges[290] the UK has set out its plans for the continuous reduction in radioactive discharges. This includes the reduction of discharges to air, soil and water as all have the potential capability of reaching the sea and adding to the existing background levels of radioactivity.

[287] If an EU Member State alters the way in which it plans to handle or dispose of radioactive materials that results in a reduction on restrictions on discharges, increases the levels of risk, or if it plans to build a new facility that handles, disposes or processes radioactive materials it must make a submission to the Commission seeking an opinion on the proposals.
[288] European Union, European Atomic Energy Community (EURATOM treaty), (1957).
[289] The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000.
[290] UK Strategy on Radioactive Discharges (http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/government/discharges/strategy/strategy.aspx)

Regional/ Local

1. The construction (and decommissioning) of facilities for treatment and controlled discharge of gaseous and liquid radioactive materials may impact on soil structure, particularly if any major pipelines are required. Best practice is to construct pipework above ground but support structures will still be required. Whilst a site specific assessment will determine the significance of such developments, at this stage of the programme, the impact is considered minimal. No affect on underlying geology is expected.

2. Deposition of radioactive particles following discharge from authorised stacks or outfalls may have a negative effect on soils and land use. New nuclear power station sites will be expected to operate within multi-media discharge authorisations issued by the Environment Agency underEPR 10. This authorisation will be supported by a comprehensive environmental monitoring and sampling regime to verify discharges.

3. Land is only considered to be 'radioactive contaminated land' under the contaminated land regime (Part 2A) if it causes or presents a significant possibility of causing harm to human health. Harm, considered in terms of lasting exposure, is defined as an annual effective dose of 3mSv or more. A significant possibility of harm refers to the probability or frequency of the occurrence of circumstances which would result in lasting exposure. Council Directive 96/29/Euratom established basic safety standards for doses to people including members of the public[291]. The effective dose limit for members of the public is 1mSv per year. The EA has concluded that the annual radiation impact on people of the AP 1000 reactor or the EPR-UK reactor would be below the UK constraint for any single source[292][293].. Therefore, deposition of sufficient radioactivity to create contaminated land under Part 2A of the Contaminated Land Regulations is not expected within the prevailing regulatory regime.

[291] European Commission, Council Directive 96/29/Euratom of 13 May 1996 Laying down basis safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation, OJ L 159, 29, (1996). http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf
[292] Environment Agency Generic Design Assessment of New Nuclear Power Plant Designs, Statement of findings following preliminary assessment of submission by: Westinghouse Electric, Company LLC for their AP100 design, (March 2008). http://www.environment-agency.gov.uk/static/documents/Business/AP1000.pdf page 3
[293] Environment Agency), Generic Design Assessment of New Nuclear Power Plant Design summary document, Statement of findings following preliminary assessment of submission by: AREVA NP SAS and Electricité de France SA for their UK-EPR design (March 2008) http://www.hsfor exampleov.uk/newreactors/reports/arevasummary.pdf page 1

4. In relation to potential land use after decommissioning, it should be noted that the HSE has published its criteria for delicensing land on a licensed nuclear site. Effectively the licensee has to demonstrate that any traces of radioactivity found on licensed land presented "no danger" before the HSE will delicense that area. The HSE has specified "no danger" as a risk to anyone occupying the site for any reasonable purpose would be of less than one death in one million per year. This equates to an annual dose of approximately twenty micro-sieverts (20 µSv) per year[294].

Summary of Potential Effects:	Timescale	C	O	D
	Significance	0	0	0
	Likelihood	M	M	M

Significant Effects	Mitigation and Monitoring Possibilities
• The effect of gaseous and liquid radioactive discharges on soils, geology and land use is not considered to be significant.	• n/a

[294] Health and Safety Executive HSE Criterion for Delicensing Nuclear Sites, (May 2005) http://www.hsfor exampleov.uk/nuclear/delicensing.pdf

Gaseous and Liquid Radioactive Discharges: Water Quality and Resources

AoS Objective:

to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology)
to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives
to avoid adverse impacts on the supply of water resources
to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives

Guide questions:

Will it result in the increased sedimentation of watercourses?
Will it adversely affect channel geomorphology?
Will hydrology and flow regimes be adversely affected by water abstraction?
Can the higher defence standards be achieved without compromising habitat quality and sediment transport?
Will it result in the sediment loading of watercourses?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it affect designated Shellfish Waters?
Will it affect Freshwater Fish Directive sites?
Will it increase turbidity in watercourse?
Will it increase the temperature of watercourses?
Will it adversely affect water supply as a result of abstraction?
Will it significantly increase demand for water?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local water resources both surface water and groundwater
- National and International Marine Waters
- Sensitive marine and freshwater habitats, identified in site specific reports

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. There is the potential for elevated levels of radioactivity in seawater and freshwater as a result of discharges. While controlled directly under EPR 10 Authorisations and the Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000[295], the UK is also committed to making its contribution to the delivery of the OSPAR Convention on the Protection of the marine environment of the North-East Atlantic. Through the publication of the UK Strategy on Radioactive Discharges[296] the UK has set out its plans for the continuous reduction in radioactive discharges. This includes the reduction of discharges to air, soil and water as all have the potential capability of reaching the sea and adding to the existing background levels of radioactivity.
3. Measured local levels for the existing PWR at Sizewell B (see below) indicates no significant impact for International/National and Transboundary waters. No significant effects on international, national or transboundary water quality or resources will arise from discharges that are controlled in accordance with the relevant national and international regulations.

Regional/ Local

1. There is the potential for elevated levels of radioactivity in seawater and freshwater as a result of discharges. Discharges will be controlled under EPR 10 Authorisations. It is part of a site's conditions that any release of radiation into the environment is monitored to ensure that unauthorised discharges do not occur. Measured levels of radioactivity in freshwater and seawater in the vicinity of the only existing commercial power generating PWR in the UK, Sizewell B, are considerably lower than the World

[295] The Radioactive Substances (Basic Safety Standards) (England and Wales) Direction 2000.
[296] UK Strategy on Radioactive Discharges (http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/government/discharges/strategy/strategy.aspx)

Health Organisation guidance levels for radionuclides in drinking water[297,298].

2. In the second stage of their assessment of the EPR design[299, 300], the EA commented that, to comply with the UK strategy for liquid discharges, the design will need to consider the site specific discharge location and its dispersion.

3. The construction and operation of new nuclear power stations will require additional EPR 10 permits[301] to be granted. An increase in the number of nuclear facilities' emission authorisations could potentially result in a greater cumulative release of radioactive emissions into surface and groundwater sources across the country. These limits are determined, authorised and regulated by the Environment Agency and are limited by the impact they may pose to the local environment

4. A programme of new nuclear power stations will produce additional quantities of Low Level Waste (LLW) for disposal off-site at the Low Level Waste Repository (LLWR) or other suitable facilities. At the LLWR, measurements in 2004 showed that the exposure of representative members of the public is less than 0.005 mSv/y or less than 0.5% of the public dose limit[302]. LLW arisings from the new build programme are small in the context of legacy wastes (currently deposited at Low Level Waste Repository and predicted for disposal) and the contribution of this to discharged radioactivity will be minor.

5.

Summary of Potential Effects:	Timescale	C	O	D
	Significance	0	0	0
	Likelihood	M	M	M

Significant Effects	Mitigation and Monitoring Possibilities

[297] Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Radioactivity in Food and the Environment, 2007, RIFE-13, (2008), http://www.cefas.co.uk/publications/rife/rife13.pdf.
[298] World Health Organisation (WHO) Guidelines for Drinking Water Quality, Volume 1, Recommendations, 3rd Edition, (2008). http://www.who.int/water_sanitation_health/dwq/fulltext.pdf page 202
[299] http://www.environment-agency.gov.uk/static/documents/Business/EPR.pdf
[300] http://www.environment-agency.gov.uk/static/documents/Business/AP1000.pdf
[301] http://www.opsi.gov.uk/acts/acts1993/ukpga_19930012_en_1. The second stage of the Environmental Permitting programme (EPP2) will incorporate the requirements of the Radioactive substances Act 1993
[302] NDA, LLW Strategic Environmental Assessment, http://www.nda.gov.uk/documents/upload/UK-Nuclear-LLW-Strategy-Site-Specific-Baselines-Part-I-England-June-2009.pdf page 47

• An increase in the number of nuclear facilities' emission authorisations has the potential to result in a greater number of releases of radiation emissions into surface and groundwater sources across the country. The limits for these discharges are determined, authorised and regulated by the Environment Agency and are limited by the impact they may pose to the local environment, taking account of any interactions between discharges. • Hence, no significant effects are expected on water quality or resources from controlled radioactive discharges because of the safeguards provided by the regulatory regime.	• No mitigation is required as no significant effects have been identified but this finding is based on the regulation of radioactive discharges and environmental monitoring required by Site Specific Authorisations under EPR 10 and reported in RIFE[303] and Pollution Inventory. • Improved abatement technologies current guidance in Environment Agency TGN M11[304] and M12[305] • Monitoring of the local environment is a requirement of authorisations issued under the Environmental Permitting Regulations 2010 for large Nuclear Licensed sites. Any effect on the local environment must therefore monitored, recorded, and controlled to maintain compliance with the site's EPR 10 authorisation.

[303] The Annual Radiation in Food and the Environment Report by CEFAS
[304] Environment Agency, Technical Guidance Note M12 http://www.environment-agency.gov.uk/static/documents/5-PMHO1299BKHG-e-e.pdf
[305] Environment Agency, Technical Guidance Note M11 http://www.environment-agency.gov.uk/static/documents/4-PMHO1299BKHJ-e-e.pdf

Flood Risk

AoS Objective:

14. To avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible

Guide questions:

Will it result in demand for higher defence standards?

Potential Receptors:

- Site workers
- Local/ District ecosystems in coastal waters

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

7. No International, National and Transboundary effects identified.

Regional/ Local

8. No effects on flood risk associated with gaseous and liquid radioactive discharges identified.

Summary of Significant Strategic Effects:

Timescale	C	O	D
Significance	0	0	-.
Likelihood	H	H	H

Significant Effects

- No significant effects identified from gaseous and liquid radioactive discharges.

Mitigation and Monitoring Possibilities

- n/a.

Section 7 Appraisal Matrices: Non Radioactive Hazardous Waste

Notes on Appraisal approach

14. The discussion of potential effects and mitigation possibilities includes the effects of waste management at nuclear power station sites, transport offsite and effects at the site for final disposal of the waste where applicable.
15. The Summary of potential effects for each topic includes the effects of waste management at nuclear power station sites and transport offsite only.
16. The Summary of potential effects is carried to the summary tables for each waste type that are presented in Section 6 of the Main AoS.

Key to Appraisal				
Key to appraisal of Strategic Effects:			**Abbreviations:**	
Significance		**Category of effect**	**Timescale**	
++	Major Significant	Development actively encouraged as it would resolve an existing sustainability problem. Effect considered to be of national/ international significance.	C	Construction stage
+	Minor Significant	No Sustainability constraints and development acceptable. Effect considered to be of national/ international significance.	O	Operation stage
0	No significance	Neutral effect	D	Decommissioning stage
-	Minor Significant	Potential sustainability issues; mitigation and / or negotiation possible. Effect considered to be of national/ international significance.	**Likelihood**	
--	Major Significant	Problematical because of known sustainability issues; mitigation or negotiation difficult and/ or expensive. Effect considered to be of national/ international significance.	H	High Likelihood
?	Uncertainty	Where the significance of an effect is particularly uncertain, for example because insufficient information is available at the plan stage to fully appraise the effects of the development or the potential for successful mitigation, the significance category is qualified by the addition of '?'.	M	Medium Likelihood
			L	Low Likelihood

Non Radioactive Hazardous Waste : Air Quality

AoS Objective:

To avoid adverse impacts on air quality

Guide questions:

Will it result in the release of radionuclides that may adversely affect human health or biodiversity?
Will contribute to an increase in the number or expansion of AQMAs?

Potential Receptors:

- Local populations close to new nuclear power station sites
- Regional and National Populations; cumulative impacts associated with new nuclear power stations

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

5. Export of hazardous waste is permitted and International or transboundary effects may result through the transportation and treatment of such wastes. However such exports occur in the context of International agreements (for example ADR for road transport[306]) and any impacts are not considered significant.

[306] The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)

Regional/ Local

1. Current UK hazardous waste arisings from all sectors is approximately 6.4 million tonnes. Excluding transfers and storage, 54%, of the waste is subject to treatment, 23% is recycled or reused 7% is incinerated and 16% is emplaced in landfill[307]. The Nuclear Sector Plan 2007 Environmental Performance Report[308] notes that the nuclear sector, including nuclear power, produced approximately 26,796 tonnes of non-radioactive hazardous waste of which 14,616 tonnes is asbestos (and this is not expected to be generated in new nuclear power stations). The report further notes that certain companies with major interests in the nuclear power sector (British Energy, UKAEA) are currently recycling more than 50% of their hazardous waste. Therefore the nuclear sector is a minor contributor to the overall UK hazardous waste arisings and whilst the impact of new nuclear power stations will be dependent on the number constructed and operated, it is probable that the overall impact will be negligible.
2. Disposal or treatment of hazardous waste will utilise existing UK waste management infrastructure. Hazardous waste will be transported to such facilities using the existing transport infrastructure. Such journeys may impact air quality. Small quantities of hazardous waste will be generated during the construction, operation and decommissioning of new nuclear power stations. However, the volume of hazardous waste associated with new nuclear power stations is small in comparison with current hazardous waste arisings and so air quality effects due to transport of this additional volume of waste is not considered significant.
3. Disposal and treatment of hazardous waste arisings from new nuclear power stations may generate emissions at hazardous waste disposal sites with the potential to have a negative effect on air quality. Such facilities are operated within the current regulatory framework (for example the Environmental Permitting (England and Wales) Regulations 2010). In the context of the current regulatory framework and due to the small amounts of hazardous waste expected from new nuclear power stations, the effect on air quality is likely to be negligible.

	Timescale	C	O	D

[307] http://www.environment-agency.gov.uk/static/documents/Research/ew_haz_waste_07__2152763.xls
[308] Environment Agency, Nuclear Sctor Plan: 2007 Environmental Performance Report, http://www.environment-agency.gov.uk/business/sectors/39789.aspx

Summary of Potential Effects:	Significance	0	0	0
	Likelihood	M	M	M

Potential Effects	Potential Mitigation and Monitoring
• No significant effects identified	• n/a

Non Radioactive Hazardous Waste: Biodiversity

AoS Objective:

to avoid adverse impacts on the integrity of wildlife sites of international and national importance
to avoid adverse impacts on valuable ecological networks and ecosystem functionality
to avoid adverse impacts on Priority Habitats and Species including European Protected Species

Guide questions:

Will it result in the loss of habitats of international/national importance?
Will it affect other statutory or non-statutory wildlife sites?
Will it result in harm to internationally or nationally important or protected species?
Will it adversely affect the achievement of favourable conservation status for internationally and nationally important wildlife sites?
Will it affect the structure and function/ecosystem processes that are essential to restoring, securing and/or maintaining favourable condition of a feature or a site?
Will the proposal enable the BAP targets for maintenance, restoration and expansion to be met?
Will the proposal result in changes to coastal evolution that is otherwise needed to sustain coastal habitats?
Will it result in the release of harmful substances for example. oil, fuel and other pollution into water bodies which could affect aquatic ecosystems?
Will it result in the accidental migration of radionuclides which could harm aquatic or terrestrial ecosystems?
Will it result in changes to stream hydrology and morphology that could affect aquatic or terrestrial ecosystems?
Will it result in thermal discharges that could adversely affect aquatic ecosystems?
Will it result in soil contamination that could damage aquatic or terrestrial ecosystems

Potential Receptors:

- Local, Regional, European, International area were hazardous waste infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

4. Hazardous waste will be generated during the construction, operation and decommissioning of new nuclear power stations. Hazardous waste arisings from new nuclear power stations will utilise capacity in UK hazardous waste infrastructure. The operation of these hazardous waste disposal and treatment facilities may impact biodiversity. However, because the waste volumes from new nuclear power stations will be small in comparison with volumes arising from other sectors, the impact from this source on international, national and transboundary nature conservation interests is considered to be negligible.

Regional/ Local

1. No additional impacts expected

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects

- No significant effects expected

Mitigation and Monitoring Possibilities

- n/a

Non Radioactive Hazardous Waste: Climate change

AoS Objective:

to minimise greenhouse gas emissions

Guide questions:

Will it take account of future effects and risks of climate change for example. sea level rise?
Will future changes in weather patterns be considered?
Will it result in increased vehicular emissions (particularly carbon dioxide)?
Will the development result in an overall reduction in greenhouse gas emissions over its life time resulting from changes in:

- Transport of people and goods
- Scope, form and methods of asset construction, maintenance and demolition
- Waste recycling and disposal
- Land management practices
- Other secondary activities in the wider local and national economy

Note: Adaptation to climate change is discussed in other relevant topic appraisals, egg. biodiversity, water, flood risk.

Potential Receptors:

- Human population and environment at all geographical scales.

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. Export of hazardous waste is permitted and international or transboundary effects may result through the transportation and treatment of such wastes. The transport of hazardous waste will generate combustion gases including carbon dioxide (a

greenhouse gas). In the context of anticipated hazardous waste arisings from new nuclear power stations and the proportion of this likely to be exported this is not considered significant.

2. Treatment and disposal of hazardous waste arisings from new nuclear power stations may indirectly generate greenhouse gases, specifically carbon dioxide from power usage. Such waste facilities are operated within the current regulatory framework (for example the Environmental Permitting (England and Wales) Regulations 2010). In the context of the current regulatory framework and due to the small amounts of hazardous waste expected from new nuclear power stations, the effect on climate change is likely to be negligible.

Regional/ Local

1. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects	Mitigation and Monitoring Possibilities
• No significant effects expected.	• n/a

Non Radioactive Hazardous Waste: Communities: Population, Employment and Viability

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it create significant pressure on local / regional / National Radioactive Waste Management Facilities
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Populations local to new nuclear power station sites and hazardous waste infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

1. No international / transboundary effects identifed

2. Generation of hazardous waste by new nuclear power stations is likely to utilise national hazardous waste infrastructure, including disposal and treatment faciltiies. Site staff at nuclear power stations may be required to manage hazardous waste during the construction, operation and decommissioning of new nuclear power stations. However, neither the onsite or offsite activities are considered to offer significant employment opportunities or other effects because of the small quantities of hazardous waste that will be generated by new nuclear power stations.

Regional/ Local

1. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	H	H	H

Significant Effects

- No significant effects expected.

Mitigation and Monitoring Possibilities

- n/a

Non Radioactive Hazardous Waste: Supporting Infrastructure

AoS Objective:

To create employment opportunities
To encourage the development of sustainable communities
To avoid adverse impacts on the function and efficiency of the strategic transport infrastructure
To avoid disruption to basic services and infrastructure
To avoid adverse impact on property and land values and avoid planning blight

Guide questions:

Will it create both temporary and permanent jobs in areas of need?
Will it result in in-migration of population?
Will it result in out-migration of population?
Will it affect the population dynamics of nearby communities (age-structure)?
Will it result in changes to services and service capacity in population centres?
Will it result in the direct loss of strategic road/rail/air/port infrastructure?
Will it result in increased congestion/pressure on key transport infrastructure?
Will it result in loss or disruption to basic services and infrastructure (for example. electricity, gas)?
Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?
Will it result in a decrease in property and land values as a result of a change in perceptions or blight?
Will it result in the loss of recreational and amenity land?

Potential Receptors:

- Populations local to new nuclear power station sites

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. No International, Transboundary effects anticipated

3. Hazardous waste from new nuclear power stations is likely to utilise existing national waste infrastructure. Current UK hazardous waste arisings from all sectors is approximately 6.4 million tonnes. Excluding transfers and storage, 54%, of the waste is subject to treatment, 23% is recycled or reused 7% is incinerated and 16% is emplaced in landfill[309].

4. The Nuclear Sector Plan 2007 Environmental Performance Report[310] records that the nuclear sector, including nuclear power, produced approximately 26,796 tonnes of non-radioactive hazardous waste of which 14,616 tonnes is asbestos (and this is not expected to be generated in new nuclear power stations). The report further notes that certain companies with major interests in the nuclear power sector (British Energy, UKAEA) are currently recycling more than 50% of their hazardous waste. Therefore the nuclear sector is a minor contributor to the overall UK hazardous waste arisings and whilst the impact of new nuclear power stations will be dependent on the number constructed and operated, it is probable that the overall impact on hazardous waste infrastructure will be negligible.

Regional/ Local

2. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

	Timescale	C	O	D
	Significance	0	0	0

[309] http://www.environment-agency.gov.uk/static/documents/Research/ew_haz_waste_07__2152763.xls
[310] Environment Agency, Nuclear Sctor Plan: 2007 Environmental Performance Report, http://www.environment-agency.gov.uk/business/sectors/39789.aspx

Summary of Potential Effects:	Likelihood	M	M	M
Significant Effects • No significant effects anticipated	**Mitigation and Monitoring Possibilities** • Application of Best Available Technique (BAT)			

Non Radioactive Hazardous Waste: Health and Well-Being

AoS Objective:

to avoid adverse impacts on physical health
to avoid adverse impacts on mental health
to avoid the loss of access and recreational opportunities, their quality and user convenience

Guide questions:

Will it adversely affect the health of local communities through accidental radioactive discharges or exposure to radiation?
Will the storage of radioactive waste result in adverse physical and mental health effects for local communities?
Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?
Will it adversely affect the health of the workforce?
Will it impact upon different vulnerable communities locally?
Will it help to reduce health inequalities?
Will the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities?
Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?

Potential Receptors:

- Local, Regional, National populations close to UK waste infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

4. Hazardous waste presents a potential danger to people and the environment. The construction, operation and decommissioning of new nuclear power stations will generate hazardous waste. Such waste will be similar to hazardous waste produced by other sectors. Hazardous waste generated by new nuclear power stations will be temporarily stored at stations prior to treatment or

disposal. The existing regulatory framework (including the Hazardous Waste Regulations 2005 (as amended) ensure that such waste can be managed safely.

5. Hazardous waste from new nuclear power stations will utilise existing waste infrastructure. Such waste volumes will be small in comparison with existing UK waste arising and the infrastructure is managed within the existing regulatory framework to minimise impact on health and well-being. Additional impacts associated with new nuclear power stations are not expected. It is possible that some hazardous waste from new nuclear power stations may be disposed of as landfill. The Landfill Directive aims to reduce the negative impacts of landfill. Inputs to landfill are controlled, by requiring waste to be pre-treated and meet waste acceptance criteria (WAC). UK Regulations requires Best Available Techniques (BAT) to be applied to landfill operations[311].

Regional/ Local

1. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects

- No significant effects identified

Mitigation and Monitoring Possibilities

- n/a

[311] http://www.environment-agency.gov.uk/cy/ymchwil/llyfrgell/safbwynt/41221.aspx

Non Radioactive Hazardous Waste: Landscape and Cultural Heritage

AoS Objective:

to avoid adverse impacts on the internationally and nationally important features of the historic environment
to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
to avoid adverse impacts on nationally important landscapes
to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness

Guide questions:

Will it adversely affect landscapes within or immediately adjacent to a National Park?
Will it adversely affect landscapes in or immediately adjacent to an AONB or NSA?
Will it adversely affect Heritage Coast or Preferred Conservation Zones?
Will it adversely affect local landscapes/townscapes of value?
Will it affect the levels of tranquillity in an area?
Will it adversely affect the landscape character or distinctiveness?
Will it result in increased levels of light pollution?
Will it adversely affect historic sites of international/national importance and their setting?
Will it adversely affect other historic sites of known value?
Will it adversely affect landscapes of historic importance?

Potential Receptors:

- Landscape and Cultural Heritage amenity associated with hazardous waste infrastructure

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

2. Hazardous waste arisings from the construction, operation and decommissioning of new nuclear powers stations will utilise existing national infrastructure capacity. Such facilities are operated to manage UK waste arisings and whilst waste from the new nuclear power stations will represent a small increase in the quantity of waste to be managed, this it is unlikely to have a significant effect on landscape or cultural heritage.

3. No effects on landscape or cultural heritage interests are expected at new nuclear power stations sites as a result of managing hazardous waste.

Regional/ Local

4. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	H	H	H

Significant Effects

- No significant impacts identified

Mitigation and Monitoring Possibilities

- n/a

Non Radioactive Hazardous Waste: Soils, Geology and Land Use

AoS Objective:

to avoid damage to geological resources
to avoid the use of greenfield land and encourage the re-use of brownfield sites
to avoid the contamination of soils and adverse impacts on soil functions

Guide questions:

Will it result in the compaction and erosion of soils?
Will it lead to the removal or alteration of soil structure and function?
Will it lead to the contamination of soils which would affect biodiversity and human health?
Will it compromise the future extraction/ use of geological/ mineral reserves?
Will it result in the loss of agricultural land?
Will it lead to damage to geological SSSIs and other geological sites?
Will it result in the loss of Greenfield land?
Will it adversely affect land under land management agreements?

Potential Receptors:

- Populations and environment close to hazardous waste infrastructure
- Populations and environment close to new nuclear power stations generating hazardous waste

Potential Effects and Mitigation Possibilities:
International/ National/ Transboundary 1. International and transboundary effects are not expected. 2. Hazardous waste from the construction, operation and decommissioning of new nuclear powers stations will use the national waste infrastructure. The construction and operation of disposal and treatment facilities for hazardous waste will entail land use and has the potential to affect soils and geology. 3. Current UK hazardous waste arisings from all sectors is approximately 6.4 million tonnes, of this 45% is subject to treatment, 19% recycled or reused and 13% emplaced in landfill312. The Nuclear Sector Plan 2007 Environmental Performance Report313 notes that the nuclear sector, including nuclear power, produced approximately 26,796 tonnes of non-radioactive hazardous waste of which 14,616 tonnes is asbestos (and this is not expected to be generated in new nuclear power stations). The report further notes that certain companies with major interests in the nuclear power sector (British Energy, UKAEA) are currently recycling more than 50% of their hazardous waste. Therefore the nuclear sector is a minor contributor to the overall UK hazardous waste arisings and whilst the impact of new nuclear power stations will be dependent on the number constructed and operated, it is probable that the overall impact on soils, geology and land use will be negligible.
Regional/ Local 5. The analysis of regional and local effects is similar to that presented in the previous section and does not raise any other significant issues.

[312] http://www.environment-agency.gov.uk/static/documents/Research/ew_haz_waste_07__2152763.xls
[313] Environment Agency, Nuclear Sctor Plan: 2007 Environmental Performance Report, http://www.environment-agency.gov.uk/business/sectors/39789.aspx

Summary of Potential Effects:	Timescale	C	O	D
	Significance	0	0	0
	Likelihood	M	M	M

Significant Effects	Mitigation and Monitoring Possibilities
• No significant effects identified.	• n/a

Non Radioactive Hazardous Waste: Water Quality and Resources

AoS Objective:

to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology)
to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives
to avoid adverse impacts on the supply of water resources
to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives

Guide questions:

Will it result in the increased sedimentation of watercourses?
Will it adversely affect channel geomorphology?
Will hydrology and flow regimes be adversely affected by water abstraction?
Can the higher defence standards be achieved without compromising habitat quality and sediment transport?
Will it result in the sediment loading of watercourses?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it affect designated Shellfish Waters?
Will it affect Freshwater Fish Directive sites?
Will it increase turbidity in watercourse?
Will it increase the temperature of watercourses?
Will it adversely affect water supply as a result of abstraction?
Will it significantly increase demand for water?
Will it cause deterioration in surface and groundwater quality as a result of accidental pollution, for example spillages, leaks?
Will it cause deterioration in surface and groundwater quality as a result of the disturbance of contaminated soil?
Will it result in the loss of floodplain?
Will it increase surface water runoff and therefore increase flood risk?
Are there alternatives to reduce the risk of flooding through secondary defences or design of the station?

Potential Receptors:

- Local water resources both surface water and groundwater
- National and International Marine Waters
- Sensitive marine and freshwater habitats, identified in site specific reports

Potential Effects and Mitigation Possibilities:

International/ National/ Transboundary

4. It is possible that some hazardous waste from new nuclear power stations may be disposed of as landfill. Emplacement of hazardous waste generated during the construction, operation and decommissioning of new nuclear power plants in landfill may generate leachate. Landfills are engineered to manage such arisings safely. The Environment Agency establishes limits and monitoring requirements to ensure controlled waters including groundwater remains safe.

5. Furthermore, because the nuclear sector is a minor contributor to the overall UK hazardous waste arisings and whilst the impact of new nuclear power stations will be dependent on the number constructed and operated, it is probable that the overall impact on water quality and resources will be negligible.

Regional/ Local

6. Hazardous waste generated during construction, operation and decommissioning may be stored temporarily at new nuclear power stations. Arrangements including engineered facilities and management arrangements will be established to prevent emissions to controlled waters.

Summary of Potential Effects:

Timescale	C	O	D
Significance	0	0	0
Likelihood	M	M	M

Significant Effects	Mitigation and Monitoring Possibilities
• No significant effects identified.	• n/a

Flood Risk

AoS Objective:

14. To avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible

Guide questions:

Will it result in demand for higher defence standards?

Potential Receptors:

- Site workers
- Local/ District ecosystems in coastal waters

Potential Significant Effects and Mitigation Possibilities:

International/ National/ Transboundary

9. No International, National and Transboundary effects identified.

Regional/ Local

10. Hazardous waste generated during construction, operation and decommissioning may be stored temporarily at new nuclear power stations. The arrangements for temporary storage are likely to be within the footprint of the power station site and so should not require any additional area of flood protection, nor any extension of the period for which flood protection is required. Hence no significant effects on flood risk associated with the management of non-radioactive hazardous waste have been identified.

Summary of Significant Strategic Effects:	Timescale	C	O	D
	Significance	0	0	0
	Likelihood	H	H	H

Significant Effects	Mitigation and Monitoring Possibilities
• No significant effects have been identified from non-radioactive hazardous waste.	• n/a.

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