DEPARTMENT OF ENERGY & CLIMATE CHANGE

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

Planning For New Energy Infrastructure

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Appraisal of Sustainability of the revised draft Nuclear National Policy Statement

The Appraisal of Sustainability (AoS), incorporating Strategic Environmental Assessment, of the revised draft Nuclear National Policy Statement (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 to the Infrastructure Planning Commission will need to be accompanied by an Environmental Statement having been the subject of a detailed Environmental Impact Assessment.

The AoS Reports are presented in the following documents:

AoS Non-Technical Summary

Main AoS Report of 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 at www.energynpsconsultation.decc.gov.uk

This document is the **Appraisal of Sustainability of the revised draft Nuclear NPS: Main Report** and is subject to consultation alongside the revised draft Nuclear NPS for a period 14 weeks from the date of publication.

This report has been produced by the Department of Energy and Climate Change based on technical assessment undertaken by MWH UK Ltd with Enfusion Ltd, Nicholas Pearson Associates Ltd, Studsvik UK Ltd and Metoc plc.

Contents

Non-Technical Summary

S.1 Introduction

S.1.1 This is a Non-Technical Summary (NTS) of the Appraisal of Sustainability (AoS) of the revised draft Nuclear National Policy Statement[1] (NPS). The AoS has been undertaken to inform the preparation of the revised draft Nuclear NPS. The AoS Report is provided in three parts: this Non Technical Summary; the Main AoS Report; and Annexes A to H which report the individual appraisals for each of the potentially suitable sites included in the revised draft Nuclear NPS. This NTS explains the following:

Background to the NPS and AoS

- the new planning regime and the role of NPSs;
- the objectives and structure of the revised draft Nuclear NPS;
- the main options considered for developing the revised draft Nuclear NPS;
- the overall approach to the AoS, and an outline of the methods and framework used in the appraisal process;
- an outline of the Strategic Siting Assessment (SSA) process;
- the challenges that were addressed in undertaking the appraisal;
- an outline of the consultation that took place during the development of the appraisal;
- an outline of the alternatives that have been considered in relation to 'Need', 'Processes' and 'Locations';
- a summary of the current situation in relation to sustainability, and the likely future situation without a Nuclear NPS; and
- the revision of the draft NPS and AoSs;

Key findings of the AoS

- an overview of the NPS findings as a whole;
- summaries of findings against the identified sustainable development themes;

[1] DECC (2010) *Appraisal of Sustainability for the Revised Draft Nuclear National Policy Statement: Main report*. This document and its appendices can be found at http://www.energynpsconsultation.decc.gov.uk

- summaries of the appraisal findings for the eight sites listed in the revised draft Nuclear NPS:
- a summary of potential interactions and cumulative effects; and
- key findings of the appraisal;

Monitoring and next steps

- an outline of how the AoS informed the preparation of the revised draft Nuclear NPS;
- an outline of proposals for monitoring the predicted effects of the revised draft Nuclear NPS; and
- discussion of next steps for the revised AoS and revised draft NPS.

The Appraisal of Sustainability and the revised draft Nuclear National Policy Statement are subject to public consultation. For more information on this consultation and how to make comments, go to www.energynpsconsultation.decc.gov.uk

S.2 Background to the National Policy Statements and Appraisals of Sustainability

The Planning Act (2008) and National Policy Statements (NPSs)

S.2.1 The Government wants a planning system for major infrastructure which is rapid, predictable and accountable. Planning decisions should be taken within a clear policy framework making these decisions as predictable as possible. The final Energy NPSs will be a blueprint for decision-making on individual applications for development consent for the relevant types of infrastructure. The final NPSs will clearly set out Government's policy insofar as it relates to planning applications for major infrastructure and will give investors the certainty they need to bring forward proposals to maintain security of supply and ensure progress towards decarbonisation.

S.2.2 In line with the Planning Act 2008, the revised draft energy NPSs are drafted on the basis that once they are designated the Infrastructure Planning Commission will be the decision making body. The Government announced in June 2010 its intention to amend the Planning Act 2008 and abolish the IPC. In its place, the Government envisages that a Major Infrastructure Planning Unit (MIPU) will be established within the Planning Inspectorate. Once established, the MIPU would hear examinations for development consent and would then make a recommendation to the Secretary of State. It would not itself determine applications; decisions would be taken by the relevant Secretary of State.

S.2.3 These proposed reforms require primary legislation. Until such time as the Planning Act 2008 is amended, the IPC will continue as set out in that Act. As a result, the NPSs will provide the framework for decisions by the IPC on applications for development consent for major infrastructure projects, and under the new

arrangements will provide the framework for recommendations by the MIPU to the Secretary of State.

S.2.4 There are six Energy NPSs that relate to energy infrastructure projects. An Overarching Energy NPS (EN-1) sets out the need, high level objectives, policy and regulatory framework for new energy infrastructure consistent with sustainable development and addressing climate change. The policy set out in EN-1 will apply to all applications subject to any modifications of the policy made in the five technology specific NPSs, which should be read in conjunction with EN-1. The five technology specific NPSs are:

- EN-2 Fossil Fuel Electricity Generating Infrastructure;
- EN-3 Renewable Energy Infrastructure;
- EN-4 Gas Supply Infrastructure and Gas and Oil Pipelines;
- EN-5 Electricity Networks Infrastructure; and
- EN-6 Nuclear Power Generation.

S.2.5 These six NPSs provide the planning policy for the IPC when it is considering applications for nationally significant energy infrastructure. They establish the need for such development , and direct the IPC as to how to assess the impacts of major energy infrastructure proposals. Developers will need to ensure that their applications for development consent are consistent with the requirements of the relevant NPS.

S.2.6 The Nuclear NPS is different from the other energy NPSs because it includes a list of potentially suitable sites for new nuclear power stations. The Nuclear NPS only has effect in relation to applications for these sites. In the event that a developer submits an application for development consent on other sites not listed in the final Nuclear NPS, the application would be considered by the IPC who would make a recommendation to the Secretary of State. The revised draft Nuclear NPS with potentially suitable sites is the subject of this AoS.

What is the revised draft Nuclear NPS?

S.2.7 The Nuclear NPS will provide the primary basis for planning decisions by the IPC on applications for development consent for a new nuclear power station on one of the listed sites. Together with EN-1, it sets out the role of nuclear power and the planning policy which applications for new nuclear power stations should be considered in accordance with. It lists the sites, nominated as part of the Strategic Siting Assessment (SSA), which have been assessed to be potentially suitable for the deployment of new nuclear power stations by the end of 2025.

S.2.8 New nuclear power stations may have negative and positive impacts on the environment and local communities. The significance of these impacts depends upon the characteristics of the local area and the detailed design of the nuclear power station. Under the new planning regime, the developer will need to provide an Environmental Statement to accompany their application for development consent.

Any new nuclear power station will be subject to nuclear site licencing and environmental discharge permits, and the operator will have to comply with the safety, security and environmental conditions set by the regulators.

S.2.9 Parts 4 and 5 of EN-1 set out the general principles that should be applied in considering development consent applications across the range of energy technologies. The Nuclear NPS sets out additional policy for the IPC when considering an application for nuclear development. Annex C of the Nuclear NPS sets out a site assessment for each of the listed site providing further site specific issues that need to be considered for development consent and site licensing. It indicates what detailed studies might be needed to evaluate the significance of the potential impact or issue, and suggests possibilities for mitigating adverse effects. This may help scope the information that needs to be provided in the Environmental Statement and should speed up the decision-making process for building new nuclear power stations.

How has the Government developed the revised draft Nuclear NPS?

S.2.10 The Government considered a number of options for developing a Nuclear NPS commencing with assessment of high level options including whether a Nuclear NPS is needed, and if so, then how should it be developed. This hierarchy of options for the NPS was subject to consultation and this is described later in Section 6 of this NTS. The hierarchy of options considered the need for a Nuclear NPS, then the processes by which the Nuclear NPS should be developed, and finally the location of potentially suitable sites. These options, and the findings identified, are summarised in Section 7 of this NTS.

S.2.11 The revised draft Nuclear NPS sets out Government policy on the role of new nuclear power in the energy mix, the Government's view that effective arrangements will exist for managing and disposing of radioactive waste from new nuclear power stations, and a list of sites in England and Wales which the Government considers to be potentially suitable for the deployment of new nuclear power stations before the end of 2025. The list of sites has been assessed through a Strategic Siting Assessment (SSA) process with exclusionary and discretionary criteria.

S.2.12 Nominations for sites were invited and eleven were received by the end of March 2009[2]; these were taken forward for the SSA process. Sites were assessed against exclusionary and discretionary criteria and were also appraised using the AoS and HRA processes. Ten of the eleven sites were assessed as potentially suitable[3] and the Government also commissioned an Alternative Sites Study to identify any other potential sites. The Government publicly consulted upon those ten sites between November 2009 and February 2010. Following the public consultation the Government has concluded that the nominated sites at Braystones and Kirksanton are not potentially suitable and confirms that Dungeness is not potentially suitable.

S.2.13 The following figure (S.2.1) shows the location of the eight potentially suitable sites included in the revised draft Nuclear NPS which are the only sites which the

[2] Bradwell, Braystones, Dungeness, Hartlepool, Heysham, Hinkley Point, Kirksanton, Oldbury, Sellafield, Sizewell and Wylfa.
[3] All of the nominated sites except Dungeness were considered potentially suitable and listed in the initial draft Nuclear NPS.

Government has assessed to be potentially suitable for the deployment of new nuclear power stations by the end of 2025.

Figure S.2.1 Potentially Suitable Sites

S.2.14 Most of the public consultation responses on the site AoS reports related to details of the characterisations of the areas around the potentially suitable sites. Any relevant corrections and clarifications have been made in the revised AoS site reports (Annexes A to H) and incorporated into this revised Main AoS Report, including the Non Technical Summary. The key revision to the appraisal is consideration of the changes to cumulative effects in the north west of England because of the removal of Braystones and Kirksanton as potentially suitable sites.

S.2.15 A key characteristic of nuclear power generation is the requirement to safely manage the radioactive waste that is produced by the nuclear power stations. The Government considers that it is technically possible and desirable to dispose of new higher-activity radioactive waste in a geological disposal facility and that this would be a viable solution and the right approach for managing waste from new nuclear power stations. It also considers that waste can and should be stored in safe and secure interim storage facilities until a geological disposal facility (GDF) becomes available.

S.2.16 This AoS has considered the arrangements for the management of radioactive waste. The findings of this appraisal have helped inform DECC's assessment of waste management and disposal arrangements for the revised draft Nuclear NPS.

S.3 Appraisal of Sustainability and other assessments

S.3.1 The Planning Act 2008[4] requires that an AoS must be carried out before an NPS can be designated. The main purpose of an AoS is to examine the likely social, economic and environmental effects of designating the NPS. If potential significant adverse effects are identified, the AoS recommends options for avoiding or mitigating such effects. In this way the AoS helps inform the preparation of the NPS to promote sustainable development.

S.3.2 The AoS of the revised draft Nuclear NPS incorporates an assessment in accordance with the requirements of the European Directive[5] on Strategic Environmental Assessment (the "SEA Directive") which aims for a high level of environmental protection and to promote sustainable development. It applies to certain plans that are likely to have significant effects on the environment. The AoS considers socio-economic effects in the same way as environmental effects are required to be assessed by the SEA Directive. The AoS has appraised the revised draft Nuclear NPS, including those generic impacts of energy infrastructure described in the draft Overarching Energy NPS (EN-1).

S.3.3 An SEA helps inform strategic decisions to inform the preparation of plans by identifying and assessing their potential significant effects. The environmental assessment process continues with project level Environmental Impact Assessment[6] (EIA). Under the new planning regime, developers will still have to submit an Environmental Statement reporting the EIA with their application for a new nuclear power station to the IPC for development consent. EIA is a process that provides information to planners, other regulators, and the public about the likely significant effects of the proposed project on the environment. By integrating the EIA process and the emerging design of a development as early as possible, potential adverse impacts can be best mitigated.

S.3.4 The revised draft Nuclear NPS has also been assessed in accordance with the European Habitats Directive[7]. The main aim of the Habitats Directive is to promote the maintenance of biodiversity for those habitats and species of European importance. The findings of the Habitats Regulations Assessments (HRA) is reported separately[8] and have been incorporated into the appraisal of biodiversity within the AoS report.

S.3.5 In a similar way to SEA, HRA is a process that progresses from strategic to project level assessments. Project level HRA is informed more precisely by the nature,

[4] The Planning Act 2008 http://www.opsi.gov.uk/acts/acts2008/ukpga_20080029_en_1
[5] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment
[6] Directive 85/337/EEC as amended by 07/11/EC, 03/35/EC the assessment of effects of certain public and private projects on the environment
[7] Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora
[8] DECC (2010) *Habitats Regulations Assessment of the revised draft Nuclear NPS: Main Report,* www.energynpsconsultation.decc.gov.uk

scale or location of a development and thus its potential adverse effects. In order to avoid adverse effects on the integrity of sites of European importance, avoidance and mitigation measures would be proposed and these could be refinements to the nature, scale or location of the proposed development.

S.4 Approach and methods for the Appraisal of Sustainability

AoS process

S.4.1 The approach to the AoS was modelled on the Government's guidance[9] for preparing SEAs and Sustainability Appraisals, as there is no guidance yet on preparing an AoS. This is a staged approach as outlined in the following figure:

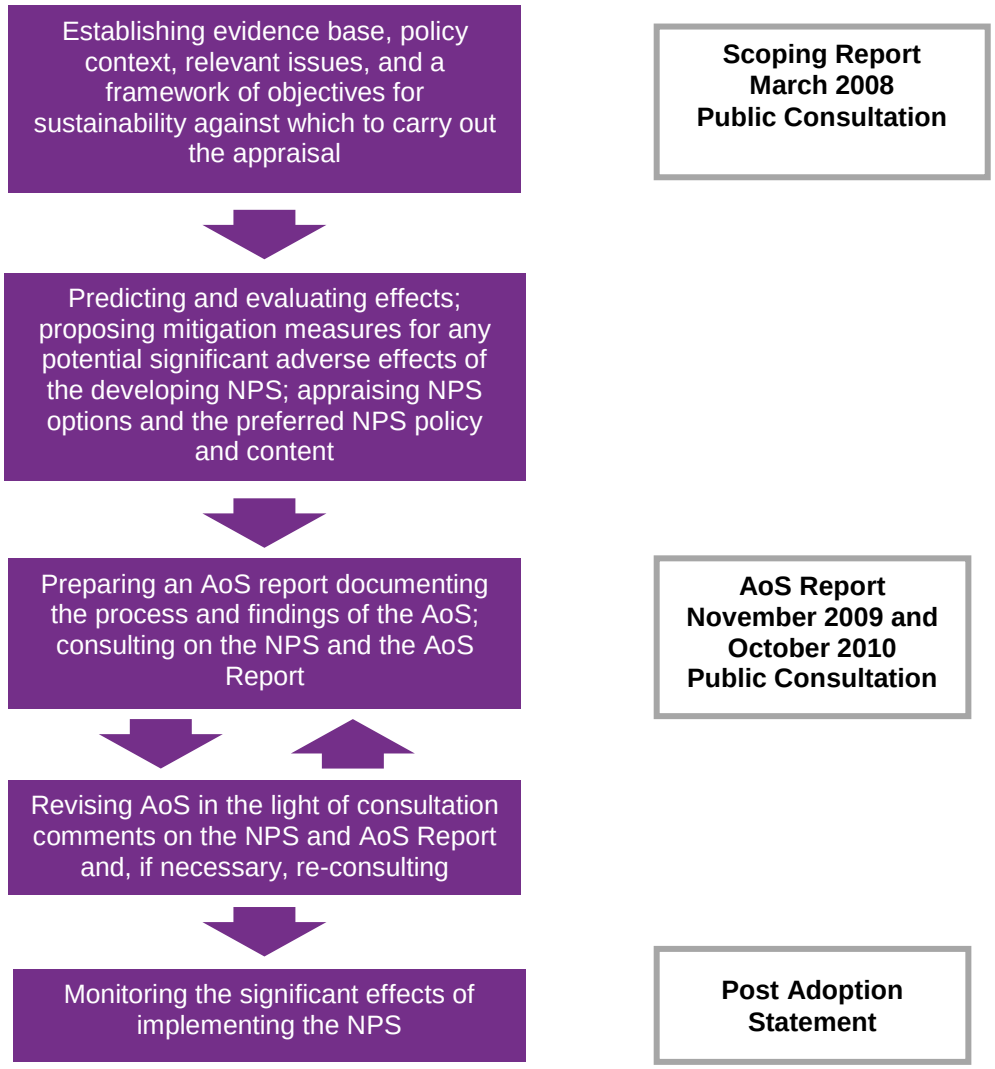

Figure S.4.1 Government's guidance for preparing SEAs and Sustainability Appraisals

[9] ODPM (2005) *A practical guide to the Strategic Environmental Assessment Directive* and ODPM (2005) *Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents*

Policy context and baseline characterisation

S.4.2 Relevant plans, programme and environmental protection objectives, together with key baseline information at international and national levels were detailed for each topic in Appendix A and B of the Scoping Report (March 2008). Relevant key strategic plans and programmes include the following[10]:

- Habitats Directive (1992), Birds Directive (1979), Ramsar Convention (1971), UK Biodiversity Action Plan (1994) *(SEA topic: biodiversity, fauna, flora)*
- Convention on Nuclear Safety (1994), EURATOM Directive protecting health from ionising radiation (1996), UK Egan Review (2004), Sustainable Communities (2003) *(SEA topics: population, human health)*
- Soil Strategy for England (2009) *(SEA topic: soil)*
- Water Framework Directive (2000), UK Water Resources Strategy (2001), UK Strategy for Flood & Coastal Erosion Risk Management (2005) *(SEA topic: water)*
- Kyoto Protocol (1997), Air Quality Framework Directive (1996), UK Climate Change Act (2008) UK Climate Impacts Programme (2009) *(SEA topics: Air, climatic factors)*
- Hazardous Waste Directive (1991) *(SEA topic: material assets)*
- UK Historic Environment (2001) (SEA topic: cultural heritage)
- UK protected landscapes: National Parks, Areas of Outstanding National Beauty, historic coasts *(SEA topic: landscape)*
- Integrated Pollution Prevention & Control Directive (1996), OSPAR Radioactive Substances Strategy, UK Sustainable Development Strategy (2006) *(SEA topics: interrelationships)*
- Aarhus Convention (1998) (SEA consultation)
- River Basin Management Plans
- Renewable Energy projects

S.4.3 The key policy context for each topic is discussed in section 2 of the relevant appendix (A1-A11) at the strategic level. The key policy context for each site is set out in section 3 of each Site AoS Report (Annexes A-H) for the regional and local levels. The scope of the AoS considered the environmental, social and economic effects of the revised draft Nuclear NPS. The UK Sustainable Development (SD)

[10] This is not an exhaustive list. Further details about relevant plans and programmes can be found in BERR (2008) *Consultation on Strategic Environmental Assessment Scoping Report for Proposed National Policy Statement for New Nuclear Power – Appendices and Figures*, URN 08/680AN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45241.pdf and BERR (2008) *Applying the proposed Strategic Siting Assessment Criteria: a study of the potential environmental and sustainability effects – Appendices,* URN 08/926ANN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file47140.pdf

Strategy (2005) sets out five guiding principles to help achieve sustainable development, the goal of which is defined as "*to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life of future generations*". The Strategy further identifies four priority areas for immediate action: sustainable consumption and production; climate change and energy; natural resource protection and environmental enhancement; and sustainable communities.

S.4.4 Detailed baseline data at international and national levels was set out for each relevant topic in Appendix B of the Scoping Report (March 2008)[11] and included baseline trend data where available. Baseline data at regional and local levels for each potentially suitable site for new nuclear power stations is provided in Appendix 4 to each Site AoS report (Annexes A-H) and informed the characterisation for each site described in section 4 of each Site AoS Report. This is also set out according to relevant topics and provides the baseline against which the appraisals were carried out.

S.4.5 Key issues and opportunities for sustainability were detailed in Appendix C of the Scoping Report (March 2008). Key considerations identified included noting that many internationally designated sites for biodiversity are located in estuarine and coastal locations. New nuclear power stations are likely to be in coastal or estuarine locations because of requirements for cooling water. New nuclear power stations will add to the legacy of radioactive waste. This is discussed further in the following sections 9 (the current situation) and 10 (the likely future situation) of this NTS.

Appraisal framework

S.4.6 The scope of this AoS was identified through analysis of relevant baseline information, the policy context of key policies, plans and programmes, the relevance to the developing revised draft NPS, and responses to the scoping consultation carried out in March 2008. The appraisal itself was carried out using a set of sustainability objectives as a way of identifying and evaluating the potential significant effects of the revised draft NPS on communities and the environment. These objectives for appraisal, organised into topics and themes for sustainable development, were developed through consideration of the plans and programmes relevant to the revised draft Nuclear NPS, the requirements of the SEA Directive, and the responses to scoping consultation.

S.4.7 The SEA Directive suggests a range of topics for assessing a plan including biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage, landscape and the inter-relationships between these factors. All these topics were considered to be variously relevant to appraising the developing draft Nuclear NPS and the AoS objectives for these topics were grouped into Sustainable Development (SD) themes to help with appraising different aspects of the revised draft NPS.

[11] BERR (2008) *Consultation on Strategic Environmental Assessment Scoping Report for Proposed National Policy Statement for New Nuclear Power – Appendices and Figures*, URN 08/680AN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45241.pdf The information can also be found in BERR (2008) *Applying the proposed Strategic Siting Assessment Criteria: a study of the potential environmental and sustainability effects – Appendices, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file47140.pdf*

S.4.8 The AoS objectives used were as follows:

Table S.4.1 Sustainable Development theme and AOS objectives

Sustainable Development (SD) theme and AoS objectives (numbers in brackets refer to the numbers listed for the AoS Objectives in the Scoping Report March 2008)
SD Theme: Climate Change (Mitigation)
• to minimise greenhouse gas emissions (13)
SD Theme: Biodiversity and Ecosystems
• to avoid adverse impacts on the integrity of wildlife sites of international and national importance (1)
• to avoid adverse impacts on valuable ecological networks and ecosystem functionality (2)
• to avoid adverse impacts on Priority Habitats and Species including European Protected Species (3)
SD Theme: Communities – population, employment, and viability
• to create employment opportunities (4)
• to encourage the development of sustainable communities (5)
• to avoid adverse impacts on property and land values and avoid planning blight (10)
SD Theme: Communities – supporting infrastructure
• to avoid adverse impacts on the function and efficiency of the strategic transport infrastructure (8)
• to avoid disruption to basic services and infrastructure (9)
SD Theme: Human Health and Well-Being
• to avoid adverse impacts on physical health (6)
• to avoid adverse impacts on mental health (7)
• to avoid the loss of access and recreational opportunities, their quality and user convenience (11)
SD Theme: Cultural Heritage
• to avoid adverse impacts on the internationally and nationally important features of the historic environment (22)
• to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes (23)
SD Theme: Landscape
• to avoid adverse impacts on nationally important landscapes (24)
• to avoid adverse impacts on landscape character, quality and tranquillity,

diversity and distinctiveness (25)
SD Theme: Air Quality
• to avoid adverse impacts on air quality (12)
SD Theme: Soils, Geology, Land Use
• to avoid damage to geological resources (19)
• to avoid the use of greenfield land and encourage the re-use of brownfield sites (20)
• to avoid the contamination of soils and adverse impacts on soil functions (21)
• to avoid damage to geological resources (24)
SD Theme: Water Quality and Resources
• to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology) (15)
• to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives (16)
• to avoid adverse impacts on the supply of water resources (17)
• to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives (18)
SD Theme: Flood Risk
• to avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible (14)
Climate Change (Adaptation) is cross-cutting and has the potential to affect several of the above objectives for sustainable development, in particular biodiversity and flood risk.
Radioactive and associated hazardous waste is cross-cutting and has the potential to affect many of the above objectives for sustainable development. As this topic is unique to new nuclear power stations, consideration of the likely significant effects is dealt with as a separate chapter in the AoS.

S.4.9 Often topics are inter-related, for example, new flood defences may change movements of sediments and thus affect the ecology of a nearby wetland. Therefore, a number of sub-objectives or guide questions were identified through the scoping process for each of the AoS objectives to structure the appraisal.

S.4.10 The potential effects of the revised draft Nuclear NPS may be positive or negative and where potential significant adverse effects were identified, mitigation measures have been suggested. Each topic was appraised using the professional judgment of the report contributors and available information. Any gaps in information or uncertainty about the appraisal have been recorded. Outline proposals for monitoring the predicted effects have been suggested for when the NPS is designated.

S.4.11 The nature and significance of predicted potential effects were recorded using symbols and colours and a grading system as shown in the following table:

Key: Significance and Categories of Potential Strategic Effects		
Major positive	++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
Minor positive	+	No sustainability constraints and development acceptable; effect considered to be of regional/national/international significance
Neutral	0	Neutral effect
Minor Negative	-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
Major Negative	--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/international significance
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 the symbol?

S.4.12 The other revised draft Energy NPSs have been subject to AoS with a similar approach and the AoS frameworks have been shown to be compatible.

Geographical and temporal scope of the appraisal

S.4.13 The revised draft Nuclear NPS lists sites in England and Wales which are potentially suitable for deployment by the end of 2025. Therefore the focus of the AoS was on the effects associated with England and Wales, although consideration was given to any significant effects for the rest of the UK and any transboundary effects. The designated Nuclear NPS will remain until withdrawn or suspended by the Government and be kept under review to ensure that it remains valid.

S.4.14 The Nuclear AoS includes appraisal of both the effects of the whole revised draft NPS and the specific effects of potentially suitable sites. Generic design characteristics for new nuclear power stations were considered for the appraisal since the detailed design will be addressed at the project EIA stage. The timescales for appraisal were as follows:

- construction - 6 years;
- operation - approximately 60 years;
- decommissioning - approximately 30 years; and
- interim storage of waste: approximately 100 years after operation ceases[12].

[12] The site lifetime of 166 years assumes 6 years for construction, 60 years for operation and 100 years for interim storage of spent fuel after the last defueling. It is possible to envisage a scenario in which onsite interim storage might be-required for

Significant transboundary effects

S.4.15 It was concluded that significant transboundary effects are unlikely. Due to the robustness of the UK's regulatory regime, there is a very low probability of an unintended release of radiation and routine radioactive discharges from new nuclear power stations will need to be within authorised limits. The revised draft Nuclear NPS and its accompanying AoS and HRA reports have been sent to EU Member States.

S.5 The Appraisal of Sustainability and the Strategic Siting Assessment processes

S.5.1 The AoS is an ongoing process that develops as responses to consultation are considered and as the revised draft Nuclear NPS itself is developed. From the scoping stage in March 2008, the process leading to the preparation of the Nuclear NPS proposed an integration of the processes of plan making and appraising sustainability. This includes the SSA process for identifying potentially suitable sites for new nuclear power stations; the SSA criteria were subject to appraisal using the AoS framework of objectives for sustainability[13]. An overview of the interactions of the NPS, SSA and AoS processes are shown in the following diagram:

around 160 years from the start of the power station's operation, to enable an adequate cooling period for fuel discharged following the end of the power station's operation. In making its assessment that onsite interim storage might be needed for 160 years, the Government took a conservative approach, to ensure that local communities are aware that it is possible that onsite interim storage might be required for this length of time. Following the public consultation, the Government has revised its position. The Government recognises that onsite interim storage might be required beyond 2130, particularly in the event that a GDF is not available to take the waste, but the Government does not expect onsite interim storage to be required for as long as 160 years. Further detail is set out in The Government Response to the consultation on the draft National Policy Statements for Energy, DECC, 2010, www.energynpsconsultation.decc.gov.uk

[13] BERR (July 2008) *Applying the proposed Strategic Siting Assessment Criteria: a study of the potential environmental and sustainability effects*

S.6 Addressing challenges in undertaking the AoS

S.6.1 The revised draft Nuclear NPS is a national level policy document and its impacts will be felt overall at the national level but also most particularly at the local levels where new nuclear power stations are built. The revised draft Nuclear NPS is different because it includes both strategic and spatial aspects. In order to address the main difficulty of keeping the appraisal strategic for a national plan and maintaining the appraisal for the sites at a strategic level, the appraisal recognised two levels of significance of likely effects – at the national and at the local levels. It was important not to duplicate the project level assessments (EIA and HRA) that the IPC will consider in their decision making at the development consent application stage. Any uncertainties in the findings of the appraisal or gaps in the information were recorded in the detailed appraisal matrices. Recommendations were made from the AoS to the revised draft NPS to highlight to the IPC where they should consider more detailed studies, such as specific habitat or species surveys, to address uncertainties at the project level stage.

S.7 How have we consulted on the development of the AoS?

S.7.1 The AoS for the revised draft Nuclear NPS has been developed through a number of stages that reflect consultation responses and changes in legislation and guidance. A summary of the consultation is set out in the following table:

Table S.7.1 Summary of consultation

AoS Development	Consultation
The SEA Scoping Report[14] (March 2008)	Early consultation with the statutory consultees[15] and others on the scope and level of detail proposed for the SEA (now AoS).
The Environmental and Sustainability Study[16] (July 2008)	The potential environmental and sustainability effects of applying the SSA criteria were examined and this was included as part of the public consultation on the proposed SSA criteria.
The Update Report[17] (January 2009)	Reporting changes made to the SSA criteria as a result of consultation; explaining change to AoS as a result of the Planning Act 2008.
(April to June 2009)	Ongoing liaison with statutory environmental bodies, relevant regulators, and other Government departments.
AoS of the draft Nuclear NPS[18] (November 2009)	Formal consultation with statutory bodies and the public on the initial draft Nuclear NPS and the AoS.
The revised AoS Report	Formal consultation with statutory bodies and the public on the

[14] BERR (Mar 2008) *Consultation on Strategic Environmental Assessment for proposed National Policy Statement for new nuclear power*, URN 08/680QAN, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45240.pdf
[15] CCW, Cadw, Environment Agency, English Heritage, Natural England, SEPA, SNH, DoENI. DH, HPA and NII were also included.
[16] BERR (July 2008) *Applying the Proposed Strategic Siting Assessment Criteria: A study of the potential environmental and sustainability effects*, URN08/962, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file47137.pdf
[17] DECC (Jan 2009) *Applying the Strategic Siting Assessment Criteria: an update to the study of the potential environmental and sustainability effects* http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file49869.pdf
[18] DECC (2009) *Appraisal of Sustainability of the draft Nuclear National Policy Statement: Main Report*, http://data.energynpsconsultation.decc.gov.uk/documents/aos/mainreport.pdf. This incorporated an Environmental Report in accordance with the European SEA Directive 2001/42/EC

(October 2010)	revised draft Nuclear NPS and revised AoS Report

S.8 What alternatives have we considered?

S.8.1 In line with good policy and plan making objectives, and in accordance with the SEA Directive that requires consideration of reasonable alternatives, a phased approach to the appraisal of realistic alternatives[19] was taken for the revised draft Nuclear NPS as follows:

- Need – do we need the Nuclear NPS?
- Process – how should the Nuclear NPS be developed?
- Location – where should the new nuclear power stations be built?

S.8.2 The first two phases of assessment for developing the draft Nuclear NPS (covering the 'Need' and 'Process' alternatives) were appraised using the AoS Framework of objectives organised into the headline Sustainable Development topics as follows: climate change, security of energy supply, the economy, health and safety, radioactive waste, the natural environment and the built environment. This was done to reflect the strategic level of the decision making.

S.8.3 The third phase ('Location' alternatives) was appraised using the Sustainable Development themes discussed in section S.3 of this NTS. The sites that passed the exclusionary criteria in the SSA process were appraised in detail using the AoS objectives and decision-aiding questions.

S.8.4 It is noted that the two levels of sustainable development assessment used are compatible with each other. The links between the two sets of criteria are set out in Section 2 of the Main AoS report. The assessment of alternatives is explained further in the following sections:

Need – do we need the Nuclear NPS?

S.8.5 The AoS considered three possible high level options:

- a **Nuclear NPS** in line with Government policy that includes guidance for the IPC on potentially suitable sites;
- an **NPS that prohibits nuclear -** the construction of new nuclear power stations is prohibited; and
- **No NPS** which is the "business as usual" scenario where nuclear power stations could still come forward but without any guidance for the IPC or list of potentially suitable sites.

S.8.6 The three options were appraised at a high level against the Sustainable Development themes: climate change, security of energy supply, the economy, health and safety, radioactive waste, the natural environment and the built environment. The AoS findings identified that in terms of CO_2, NOx and particulate matter emissions, the construction and operation of new nuclear power stations in

[19] The Appraisal of Sustainability of the Overarching Energy NPS also considers a number of alternatives. For more information see www.energynpsconsultation.decc.gov.uk

accordance with a Nuclear NPS would result in lower emissions during operation than would result from CCGT power stations built under the NPS that prohibits Nuclear option and any CCGT power stations which came forward under the No NPS option.

S.8.7 The assessment concluded that the preferred alternative is the option of a Nuclear NPS in line with Government policy. This is based on the case for nuclear power in relation to other alternatives, and the effect it will have on the long-term ability of the UK to meet its emission reduction targets and maintain its security of supply.

Process – how should the NPS be developed?

S.8.8 The format and detail of the NPS can influence the number, location and timing of new nuclear power stations through the policy guidance and framework for decision making that it sets out for the IPC. Four potential process options for the Nuclear NPS were identified in the Scoping Report (2008) as follows:

- a Nuclear NPS with siting criteria;
- a Nuclear NPS with a list of sites;
- a Nuclear NPS with siting criteria and a list of sites; and
- a Nuclear NPS with siting criteria and a list of sites restricted to those in the vicinity of existing nuclear power stations

S.8.9 The option for a NPS with siting criteria and a list of sites was appraised as the preferred option since it would be more likely to reduce uncertainty for the IPC and thus reduce the time for a planning application to be determined. This would allow for earlier new nuclear build and better contribute to meeting the Government's climate change, security of energy supply and other sustainability objectives. In addition, the list of sites would have undergone a strategic level assessment which could reduce the likelihood of adverse sustainability effects occurring and provide a means of enabling such effects to be avoided or mitigated.

S.8.10 The revised draft Nuclear NPS uses the Strategic Siting Assessment (SSA) process to identify the location of sites potentially suitable for new nuclear power stations that could be deployed by 2025. The criteria (exclusionary and discretionary) used for the SSA were subject to appraisal in the first half of 2008 using the AoS framework of objectives. This appraisal was reported in the Environmental and Sustainability Report[20], published in July 2008, and made available alongside the consultation on the SSA process and criteria.

S.8.11 The 2008 Environmental and Sustainability Study concluded that:

- the proposed SSA criteria were broadly in line with sustainability and environmental objectives;

[20] BERR (July 2008) *Applying the proposed Strategic Siting Assessment Criteria: a study of the potential environmental and sustainability effects*

- the discretionary nature of some criteria means that adverse environmental effects cannot be ruled out at the strategic level; and

- local level impacts are not addressed by the SSA but it is made clear that these would be addressed by the nuclear regulators and others at the project level assessments.

Location - where should new nuclear power stations be built?

S.8.12 11 sites were nominated by the end of March 2009 and assessed against exclusionary and discretionary criteria, as well as a site level AoS and HRA. In each case the appraisal identified any likely strategically significant effects, for example, on international or nationally protected nature conservation. The appraisal also identified likely significant effects at the local and regional levels, for example, cumulative effects for community prosperity through long term employment.

S.8.13 DECC considered the emerging AoS findings, together with a HRA assessment, other information provided by the nominators, various technical specialists, the regulators and the statutory environmental authorities, in order to inform their assessment of nominated sites and to help inform the development of the draft Nuclear NPS.

S.8.14 The Government also commissioned an Alternative Sites Study[21] to identify other potential alternative sites. The study drew on a number of information sources to identify sites that might be "*worthy of further consideration*" by the Government to determine whether these sites were likely to meet the SSA criteria. Three sites were identified through this process; Druridge Bay in Northumberland, Kingsnorth in Kent, and Owston Ferry in Lincolnshire. A site AoS and site HRA were undertaken for each of these sites[22]. Having considered evidence from the public consultation, in addition to evidence from inter alia, the Spring 2009 opportunity for public comments, regulators, the Appraisal of Sustainability and Habitats Regulations reports, the Government has concluded that the sites identified by the Alternative Sites Study are not potentially suitable because they are not credible candidates for the deployment of new nuclear power stations by 2025.

S.8.15 One nominated site, Dungeness, did not pass the discretionary criteria on international sites of ecological importance and there were also concerns about flood risk and coastal processes. The Government therefore concluded that ten sites were potentially suitable[23] and these were included in the initial draft Nuclear NPS which was published in November 2009 for public consultation. As a result of the responses received during that consultation, the Government has concluded that Braystones and Kirksanton are not potentially suitable and confirms that Dungeness is not potentially suitable. The revised draft Nuclear NPS lists eight sites identified as potentially suitable for the deployment of new nuclear power stations by 2025.

[21] Atkins Ltd for DECC (2009) *A consideration of alternative sites to those nominated as part of the Government's Strategic Siting Assessment process for new nuclear power stations*, http://data.energynpsconsultation.decc.gov.uk/documents/atkins.pdf
[22] These are available at www.energynpsconsultation.decc.gov.uk
[23] Braystones, Bradwell, Hartlepool, Heysham, Hinkley Point, Kirksantion, Oldbury, Sellafield, Sizewell and Wylfa

S.8.16 The individual Site AoS reports set out the sustainability characteristics of the potentially suitable sites and include key issues that were recommended for the revised draft NPS to include as particular considerations for the IPC to take into account when determining individual planning applications for new nuclear power stations. The findings of the revised site level AoSs are available as Annexes A to H of the Main AoS report (for the eight sites included in the revised draft NPS), and a summary of their findings is presented later in this Non Technical Summary. The nominated sites considered in the revised AoS of the revised draft NPS are as follows:

- Bradwell (Annex A);
- Hartlepool (Annex B);
- Heysham (Annex C);
- Hinkley Point (Annex D);
- Oldbury (Annex E);
- Sellafield (Annex F);
- Sizewell (Annex G); and
- Wylfa (Annex H).

S.8.17 The revised AoS reports for the sites at Braystones, Dungeness and Kirksanton are also available at www.energynpsconsultation.decc.gov.uk.

S.9 What is the current situation and issues for sustainability?

S.9.1 Increased development and current lifestyles have resulted in a growing demand for electricity. Current Government energy policy is set towards meeting its climate change objectives, becoming a low carbon economy and ensuring energy security. The current situation and key issues for sustainable development and the revised draft Nuclear NPS may be summarised by sustainable development theme as follows:

- *Climate Change*: The climate of the UK is changing and increased emissions of greenhouse gases (GHGs) from human activities into the atmosphere is widely recognised as one of the main contributors to global warming. Climate change represents a significant risk to ecosystems, the economy and human populations and could lead to a number of significant changes to environmental conditions. These changes are likely to exacerbate current environmental trends across the UK, such as the continued loss of natural habitats and biodiversity and increased pressure on water resources. The Government is committed under the Kyoto Protocol to reduce emissions of GHGs by 12.5% below 1990 levels by 2012.
- *Biodiversity*: The UK Government's commitment to the Convention on Biological Diversity (1992) is delivered through the UK Biodiversity Action Plan

that aims to contribute to a significant reduction of the current rate of biodiversity loss. The Government has set a target for 95% of land and sea features designated in the UK as SSSI, SPA or SAC to be in either favourable condition or recovering by 2010. As of 2008, the conditions of features were below the target at generally between 60% and 80%.

- *Sustainable Communities*: The Egan Review (2004) sets out key objectives for ensuring that opportunities to access employment are considered. In certain areas road traffic is already at high stress levels and is predicted to grow for a variety of reasons, but typically as a result of general development. UK transport policy is designed to encourage more sustainable travel choices. Waste in the UK continues to grow but national policy continues to focus on the waste hierarchy in order to reduce waste and improve the efficient use of resources. The security of energy supplies in the UK is a major issue.

- *Health*: The Index of Multiple Deprivation (IMD) shows that the south east and east of England are the least deprived areas in the UK. Generally, areas of health concerns relate to increasing levels of obesity and geographical inequalities in the UK. Other key issues for energy infrastructure include the suitability of housing and the extent of fuel poverty. The increase of life expectancy contributes to the demand for electricity. The importance of access to open space for recreational activities is recognised by the Government in current planning policy. The UK has a strict regulatory regime to protect people and the environment with regard to radiological (nuclear) factors.

- *Cultural Heritage and Landscape*: Important landscape, cultural and historic features are protected in the UK and it was noted that loss of the heritage resource is difficult to mitigate. Generally across Europe there is a recognition that landscape diversity and quality is deteriorating. In the UK, areas where landscape character is neglected are generally close to major population and transport routes.

- *Air Quality*: in the UK air quality has generally improved since 1997 when the first Air Quality Strategy was adopted. One of the dominant sources of sulphur dioxide in the UK is power generation from the burning of fossil fuels; the largest source of nitrogen oxide is traffic. Compared to fossil fuel generating stations, nuclear power stations do not emit significant quantities of carbon dioxide, sulphur dioxide, nitrogen oxides or particulates.

- *Soils and Geology*: The EU has proposals for a Soil Framework Directive (2007) that aims to prevent further degradation of soil and preserve its functions. Soils, geology and the use of land are protected by various policies in the UK.

- *Water Quality and Resources; Flood Risk*: Water includes consideration of environmental and human health protection and the sustainable use of resources; all aspects of water are interconnected and often interact with other factors such as biodiversity. The EU Water Framework Directive (2000) aims to prevent further deterioration of aquatic ecosystems and associated wetlands. The UK Water Strategy (2008) aims to improve the water environment and ensure sustainable water management. Generally water quality in the UK is

expected to increase or remain unchanged and fit with the target to achieve good ecological status by 2027. Increases in population coupled with the predicted effects of climate change will increase pressure on water resources and increase flood risk. The UK Strategy for Flood and Coastal Erosion Risk Management (2005) provides key policy context on managing risk and increasing resistance and resilience. Large parts of England are at risk from flooding from rivers and the sea. About 5 million people live in floodplains or areas identified as being at risk of coastal flooding in England and Wales.

S.10 What is the likely future situation without a Nuclear National Policy Statement?

S.10.1 Nuclear generation is a proven, low carbon technology. In the absence of new nuclear power stations, it is likely that gas fired generation would be largely built instead which would increase carbon dioxide emissions[24]. The Government believes that to ensure the UK's future energy is secure, clean and affordable, the UK needs a mix consisting of renewables, fossil fuels with CCS and nuclear. Key sustainability topics relevant to the Nuclear NPS, such as climate change, energy and communities are all closely interrelated with complex interactions.

S.10.2 At each of the eight potentially suitable sites, if new nuclear power stations were not developed it is not certain what infrastructure (if any) might be developed at that particular site. Therefore it is difficult to predict the effects of the likely future situation at those sites without a Nuclear NPS.

S.11 The key likely significant effects of the revised draft Nuclear National Policy Statement

Overview

S.11.1 The revised draft Nuclear NPS has the potential for effects on communities and the environment nationally and at the regional or local level. Some effects are common to new nuclear power stations, for example, effects associated with the requirement for water for cooling. However, the significance of such effects depends upon the detailed design together with the characteristics and sensitivities of the local communities and environment.

S.11.2 This section S11 summarises the findings of the AoS of the revised draft Nuclear NPS according to the Sustainable Development themes and objectives for sustainability (e.g. environmental characteristics, likely effects and possible mitigations). Section S12 summarises the key findings of the AoS for each site. The AoS identified certain key recommendations that were generally applicable to the revised draft NPS as follows:

The AoS recommended that the revised draft NPS should guide the IPC to the findings of the site level AoSs to help scope the studies needed for the project level EIAs and any Sustainability Assessments. The AoS recommended that the revised draft NPS should advise the IPC that the significance of effects can only be

[24] See Chapter 3 of the main Appraisal of Sustainability report for more information

determined through site level studies and that a requirement for an Environmental Management Plan as part of the EIA will help ensure that any commitments to mitigating any significant impacts will be implemented.

Climate Change (mitigation)

S.11.3 Nuclear power is a low carbon energy source and associated with lower greenhouse gas emissions when compared to fossil fuels. The AoS identified that there are likely to be positive effects on this sustainability objective and the significance of these effects will increase with the number of nuclear power stations in operation. Climate change adaptation is cross-cutting and covered where relevant within the following sections on biodiversity and flood risk.

The AoS made no key recommendations and the AoS identified overall that there are likely to be significant positive effects that will contribute to meeting the UK climate change commitments.

Biodiversity and Ecosystems

S.11.4 The AoS identified that all the sites included in the revised draft Nuclear NPS will have likely significant strategic adverse effects on national and European sites of biodiversity value. The significance of these effects and the effectiveness of mitigation possibilities depend upon the specific sensitivities of the sites together with details of design and site layout. This will be addressed alongside wider effects on local biodiversity during the project level HRA and EIA assessments. There can be possibilities to mitigate certain potential adverse effects on biodiversity, for example, project design to avoid sensitive areas, and habitat retention and species protection measures on site.

S.11.5 The HRA identified that all the sites have the potential for an adverse effect on European site integrity. The HRA recommended that further project level HRAs should be required and the revised draft Nuclear NPS requires that for new nuclear power stations any development consent will be required to be supported by a detailed HRA at the project level, including Appropriate Assessment where necessary.

S.11.6 The AoS identified the common implications for effects on biodiversity (international, national and local importance) and ecosystems from new nuclear power stations:

- Water discharge, abstraction and quality;
- Habitat and species loss and fragmentation;
- Coastal squeeze;
- Disturbance events (noise, light and visual); and
- Air quality.

S.11.7 The AoS identified that there are key inter-relationships between biodiversity and other sustainability effects, most notably flood risk management, health and well-

being, and sustainable communities. Significant cumulative effects are also possible in relation to proposed adaptation measures for climate change, and in relation to water quality and resources, flood risk, soils and geology, and air quality. Interactions and cumulative effects are likely where more than one new nuclear power station may be built and for biodiversity this may be significant with the cluster of two sites on the Severn Estuary (Oldbury and Hinkley) and two sites (Bradwell and Sizewell) on the Outer Thames Estuary. Consideration will also need to be given to cumulative effects of other major developments and infrastructure projects.

The AoS recommended that the revised draft NPS should advise the IPC that the significance of biodiversity effects can only be determined through project level studies and guide the IPC to the findings of the site level AoSs and site HRAs to help agree the scope of the studies needed for the project level EIAs and HRAs. Overall the AoS found that there are likely to be significant adverse effects on national and European sites of biodiversity value and that the effectiveness of mitigation possibilities is uncertain and needs to be evaluated at the project level assessments. The AoS also found that there are likely to be significant adverse effects on the wider biodiversity at the local level and that these need to be evaluated during the project level EIAs.

Communities: population, employment and viability; supporting infrastructure

S.11.8 The AoS identified that there are likely to be significant positive effects for employment locally and associated economic benefit through the use of supporting services, particularly during the construction phase and this could be of regional significance. During the operational phase and in the longer term, the Nuclear NPS is likely to contribute significantly to the development of jobs nationally in the nuclear and associated industries, including enhancement of training and skills, and provision of goods and services to the nuclear industry.

S.11.9 As with any large scale construction project, there is the potential for short term adverse effects during construction if a number of sites were developed at the same time with the risk of a shortage of construction workers, local communities disturbed by an incoming workforce, and additional pressures placed on local services and transport networks. However, there are possibilities for mitigating such effects depending upon local circumstances and needs.

S.11.10 The opportunities for upskilling, education and supporting industries are likely to be more significant if there were a cluster of new nuclear power stations, particularly for the north west and south west of England. The effects of the revised draft Nuclear NPS in combination with other renewable energy projects is likely to contribute positively to objectives for regional economic development.

The AoS recommended that the revised draft NPS should advise the IPC of the potential enhancement for positive economic development effects. Overall the revised AoS found that there are likely to be significant beneficial effects on employment and viability for communities.

Health and Well-Being

S.11.11 The AoS identified the common potential implications for health and well-being from new nuclear power stations as follows:

- radiation from permitted discharges and potential hazards from accidental emissions;
- perceptions of health risks;
- safety and security;
- employment;
- emissions to water and air;
- noise; and
- accessibility to green space and exercise.

S.11.12 The existing regulatory systems for operation of nuclear power stations will continue to apply to the new build so that potential effects associated with safety, security, and radiation doses to the public and workers will be dealt with through the current nuclear licensing and health protection systems.

S.11.13 Overall, there are health benefits to be realised from having a reliable and secure supply of energy. The AoS also identified that there are indirect positive health effects associated with enhanced prosperity and long-term employment opportunities. Any indirect effects on supporting services, associated infrastructure, and health inequalities are not significant at the national scale and will be addressed during the project level assessments; this includes the adverse local effects from noise and disturbance associated with the construction of many major infrastructure projects. Nuclear power stations are often located in rural areas on the coast with potential conflicts for recreation and amenity.

The AoS recommended that the revised draft NPS should guide the IPC to consider requesting a sustainability statement / assessment for each application to ensure full consideration is given to sustainable communities and interactions between a range of sustainability issues, including the wider determinants of health. The NPS should highlight to the IPC that there may be beneficial effects for health and well-being from secure long term employment and community viability arising from new nuclear power stations. The revised AoS also recommended that the revised draft NPS should advise the IPC that nuclear power stations are often located in rural areas on the coast with potential conflicts for recreation and amenity (and their subsequent impacts on health and well-being).

Cultural Heritage

S.11.14 The predicted effects of the revised draft Nuclear NPS on cultural heritage are likely to be negative throughout all phases of development and are associated with the location and scale of development at the potentially suitable sites. The significance

of these effects will depend on the importance of the cultural heritage features, their location within the site, and their setting relative to the site. Mitigation measures may be possible, although it may be very difficult to mitigate for adverse effects on the settings of important cultural features. Overall the AoS identified that adverse effects were likely to be at a local scale, except for one site at Bradwell where the importance of the setting of nationally protected features is likely to increase the significance of the effects.

The AoS recommended that the revised draft NPS should advise the IPC that significant adverse effects to cultural heritage resources may be difficult to mitigate. Overall the revised AoS found that there are likely to be minor significant adverse effects on cultural resources except for Bradwell where the effect may be more significant. The significance and effectiveness of mitigation possibilities is uncertain and needs to be evaluated at project EIA level.

Landscape

S.11.15 The potentially suitable sites generally share certain landscape and visual characteristics since they are usually in less populated areas in rural and coastal locations that may have value for visual amenity and as landscape resources. The AoS identified that there is potential for long-term irreversible adverse effects on landscape until decommissioning. At one of the potentially suitable sites, Oldbury, cooling towers have been proposed and the significance of the adverse impacts on landscape will depend upon the height of the cooling towers. The nominator of the site, Horizon Nuclear Power, has said that a hybrid cooling design is its preferred option for Oldbury, This design would mean cooling towers of 70 metres in height[25]. The Overarching NPS also states that the IPC should be satisfied that hybrid cooling technology or other technologies are not reasonably practicable before giving consent to natural draught cooling towers[26].

S.11.16 Some adverse effects on the landscape can be mitigated by changes to the site layout, use of buffer zones, and reinstatement after the short term effects during construction. Many of the proposed power station sites will be seen in the context of existing power stations. Nationally significant adverse effects were identified for the site at Sizewell which is completely within an Area of Outstanding Natural Beauty and Sellafield due to the proximity of the Lake District National Park.

The AoS recommended that the revised draft NPS should advise the IPC that there are likely to be some visual impacts that cannot be mitigated due to the scale of new nuclear power stations; the significance of this is increased if cooling towers are proposed. The significance and effectiveness of mitigation possibilities is uncertain and needs to be evaluated at project EIA level. Overall the revised AoS found that there may be neutral or minor negative effects on landscape except for the sites at Sizewell and Sellafield where effects may be of national significance because of the national level designations associated with these sites.

[25] www.horizonnuclearpower.com/downloads/Horizon_Oldbury_cooling_tower_press_release_8_Sept_2010.pdf
[26] Natural draught cooling towers can be up to 200 metres in height.

Air Quality

S.11.17 Radioactive discharges to air are strictly controlled by the regulatory system and discussed in the section on radioactive waste. Short term air quality impacts during construction will depend upon local site specific factors, such as transport routes and proximity to residential housing and these will be dealt with during the project level EIA. Air quality is unlikely to be a significant issue, principally due to the relatively low level of air pollutant emissions from nuclear power stations during operation and the satisfactory existing air quality at the potentially suitable sites

The AoS recommended that the revised draft NPS should highlight to the IPC that impacts on air quality are unlikely to be significant but that impacts associated with the construction phase should be considered in the scope of the project level EIAs. Overall, the revised AoS found that effects on air quality are likely to be neutral.

Soils, Geology and Land Use

S.11.18 None of the potentially suitable sites are located on or adjacent to sites of national or regional geological or geomorphological importance. Some minor adverse effects were identified by the AoS at the local levels and associated with potentially contaminated land adjacent to some sites and impacts on peat superficial deposits at two sites. There is the potential for impacts on soils to affect the soil water regime which then may affect terrestrial habitats and this will be need to be considered as part of the project level EIAs and HRAs. As with any major construction project, there is an increased risk of pollution and potential contamination of soils but this will be dealt with by the appropriate environmental management controls through the EIA process.

The AoS recommended that the revised draft NPS should inform the IPC that impacts on soils may affect the soil water regime which may affect various terrestrial habitats and this will need to be considered in the project level EIAs and HRAs. Overall, the effects of the revised draft Nuclear NPS are considered to be neutral on soils and geology.

Water Quality and Resources

S.11.19 Radioactive discharges to water are strictly controlled by the regulatory system and discussed in the section on radioactive waste. The AoS identified that for all sites minor negative effects may be expected on coastal or estuarial water quality locally where cooling water is to be abstracted and/or discharged. Such effects may compromise the achievement of water quality objectives, for example, the requirements of the Water Framework Directive (WFD), which aims to maintain or achieve good status. The significance of the effects and effectiveness of mitigation possibilities depends on the location and will need to be evaluated during studies as part of the project level EIAs. Interactions from these effects on European and nationally protected habitats and species will also need to be evaluated during project level EIAs and HRAs. These abstraction and discharge activities will also be subject to Environment Agency licensing and consenting processes, though it is noted that these processes may not fully mitigate against all effects. There may be minor negative effects on water supply and waste water treatment capacity in those regions already under stress.

S.11.20 Cumulative effects are likely to occur where there are clusters of nominated sites with increased water requirements and where several sites discharge cooling waters to the same water body. These effects are likely to be significant in the south west region for the Severn Estuary. Generally, the effects of the revised draft Nuclear NPS on water quality and resources may be minor negative, although this is likely to be able to be mitigated.

The AoS recommended that the revised draft NPS should highlight to the IPC the characteristics of cooling water for new nuclear power stations and the implications for the marine and estuarial environments, including the interactions between discharges from clusters of nominated sites. The revised NPS should also inform the IPC that there could be increased water demand, particularly during the construction phase, which would be of greatest significance in those regions that are already under water stress. Generally, the revised AoS identified that minor negative effects may be mitigated.

Flood Risk

S.11.21 The beneficial effect of power generation from nuclear power stations with regard to climate change mitigation is noted earlier under the climate change topic. As a low carbon source, nuclear power stations are expected to make a positive contribution to achieving carbon reduction targets which, indirectly, should have a beneficial effect on flood risk through moderating changes in rainfall patterns and sea level rise. Climate change adaptation is primarily considered in this section with regard to flood risk management.

S.11.22 In other respects, the relationship between the revised draft Nuclear NPS and flood risk is essentially local or possibly sub-regional where a number of potentially suitable sites are in proximity to each other. It also has a number of different effects. The first of these is the local impact that the individual development may have on the risk of flooding to land adjacent to those sites. Secondly the sites themselves, which are all proposed in coastal or estuarine locations, may be vulnerable to the risk of flooding from a number of causes, coastal, storm surge, fluvial, groundwater and

pluvial. Finally flood risk management measures put in place to mitigate the impacts of flooding on or from individual sites may impact on coastal processes, hydrodynamics and sediment transport, which in turn may impact on designated habitats. All of these flood risk effects can occur during the construction, operation or decommissioning phases. As a result flood risk assessments need to take a long term view.

S.11.23 The flood risk effects to areas surrounding development sites could be either negative or positive. Negative impacts could be that flood risk is increased to the surrounding area as a result of any land raising required to protect the power stations or the footprint and layout of the sites which could impact upon floodplain storage and flood flow pathways. Positive impacts could also arise, as flood risk mitigation measures constructed as a result of the power stations could also provide flood risk protection for new and existing developments in the district. Similar negative and positive impacts could affect designated landscapes, for example, sensitive habitats could become more vulnerable to flooding, or as a result of improved defences – less vulnerable.

S.11.24 Climate change will increase flood risk from all causes. Coastal flood risk is likely to increase as a result of predicted increases in sea level and changes in storm surge. Changes to the seasonal distribution of rainfall and in the intensity of extreme rainfall events are also likely to increase flood risk. Climate change is also likely to result in changes to coastal erosion.

S.11.25 The mitigation measures that may be required to manage flood risk as a result of the revised draft Nuclear NPS could have potentially adverse effects on coastal processes and hydrodynamics. These measures have the potential to have secondary impacts on biodiversity and water quality, therefore potentially hindering the objectives and requirements of the EU Water Framework Directive.

The AoS recommended that the revised draft NPS should highlight to the IPC the need for detailed, site-specific investigations, including flood risk assessment, to determine the most appropriate and sustainable methods for protecting sites from flooding through the life cycle of the new nuclear power stations and to assess how these measures may affect flood risk in adjacent areas. Studies should also be undertaken to assess the impacts that any flood control measures may have on coastal processes and, indirectly, on ecology and biodiversity. Overall, the revised AoS identified that the effect of the revised draft NPS on flood risk and of flood risk on the sites in the revised draft NPS is likely to be negative, and the scale of the effects are likely to increase over time as a result of climate change.

Radioactive and Hazardous Waste

S.11.26 The revised draft Nuclear NPS sets out the Government's consideration of the management of radioactive wastes, in particular the disposability of new build higher activity wastes and spent fuel. It also sets out that the Government is satisfied that effective arrangements will exist to manage and dispose of the waste that will be produced by new nuclear power stations. The AoS has considered the sustainability implications of managing the different types of waste associated with the construction, operation and decommissioning of new nuclear power stations in the UK under the following headings:

- Spent Fuel;
- Intermediate Level Waste (ILW);
- Low Level Waste (LLW);
- Gaseous and liquid radioactive discharges; and
- Non-radioactive hazardous waste.

S.11.27 The AoS has identified that the effects of waste management may arise both at a nuclear power station site and offsite at other locations where packaging, transport and/or disposal of waste is undertaken. Some minor negative effects have been identified at nuclear power station sites. These are principally associated with the management and storage of spent fuel and ILW. Minor negative effects may potentially arise during construction and decommissioning of interim waste storage facilities although some of these effects, for example on soils, cultural heritage and landscape are site specific and will need to be assessed at the project level.

S.11.28 The most important consideration for offsite waste management facilities is the additional quantity of spent fuel to be disposed of from new nuclear power stations that will require final disposal in a Geological Disposal Facility (GDF) that will be managed by the Nuclear Decommissioning Authority (NDA). The significance of these effects will depend upon the number of new nuclear power stations built. It is estimated that to dispose of the spent fuel produced by a 10GW programme of new nuclear power stations operating for 60 years would increase the underground area of a GDF required for the disposal of spent fuel and High Level Waste by around 50 to 55%[27].

S.12 The potentially suitable sites with key issues for the revised draft Nuclear National Policy Statement

Introduction

S.12.1 A site level AoS has been undertaken for each of the nominated sites. These appraisals identified potential impacts and likely effects of a generic design of a new nuclear power station. The significance of potential effects and the effectiveness of possible mitigation will depend upon detailed studies carried out as part of the EIA and other studies for individual applications for development consent. The individual site AoS reports are available as Annexes A to H of the Main AoS report[28].

S.12.2 The site AoSs identified likely strategically significant effects at the national or international levels and likely locally significant effects at the local or regional level. The significance of local effects and effectiveness of mitigation possibilities for adverse effects is less certain until detailed project level studies have been undertaken. The site AoSs recommended that this information would be helpful to

[27] Summary Disposability Assessment for the APR-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

[28] These are available at www.energynpsconsultation.decc.gov.uk

the IPC when agreeing the scope of EIAs and other studies and when considering applications for development consent. Annex C of the revised draft Nuclear NPS sets out the findings of the SSA process for each listed site and includes other issues raised by the site AoSs. The following section sets out a high level summary of the environmental characteristics of the eight sites listed in the Nuclear NPS which are likely to be affected by development, a summary of the potential likely effects and possible mitigations which were identified. A more detailed analysis can be found in the AoS site reports (A-H) for each site which can be found at www.energynpsconsultation.decc.gov.uk.

Bradwell

S.12.3 The site at Bradwell is located in the east of England, to the east and south of the existing Bradwell nuclear power station and on the south side of the Blackwater Estuary at the northern extremity of the Dengie Peninsular. The site comprises largely arable farmland, a former military airfield, some agricultural buildings and areas of foreshore. There are 16 European protected sites within 20km of the site at Bradwell and ten scheduled monuments, one Conservation Area and around 132 listed buildings within an approximate distance of 5km of the site.

S.12.4 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Adverse effects on the settings of nationally designated cultural heritage sites Possible mitigations include siting the development adjacent to the existing power station and through appropriate landscaping. It is recognised that adverse effects would be difficult to mitigate.

- Adverse effects on four national and internationally protected nature conservation sites; on water quality and fish/shellfish populations in nearby coastal waters and on coastal erosion through upgrading of flood defences. Possible mitigations include careful design and siting of cooling system to minimise impact; suitable design, location and construction methods for flood defence works.

- Adverse setting effects upon nearby Scheduled Ancient Monuments and listed buildings. Possible mitigations include siting the development adjacent to the existing power station and through appropriate landscaping. It is recognised that adverse effects would be difficult to mitigate.

- Positive effects associated with long-term employment and enhanced prosperity for local communities.

- The site is not part of a cluster of nominated sites, therefore regional cumulative effects are not considered relevant. However, the potential for adverse effects from Bradwell and Sizewell on the Outer Thames Estuary SPA indicates that there may be interactions and cumulative effects on biodiversity.

Hartlepool

S.12.5 The site at Hartlepool is located on the coast in the north-east of England, in an established industrial area. The site surrounds the existing Hartlepool nuclear power station and is located at the mouth of the River Tees on the north side of the Greatham Creek, opposite Seal Sands. There are eight European protected sites within 20km of the site.

S.12.6 Key findings recommended to consider include:

- Adverse effects on at least seven national and internationally protected nature conservation sites. Possible mitigations include designing a suitable intake/outfall system design, including fish protection measures and minimisation of effects on sedimentary processes or thermal regime; use of sensitive construction techniques.
- Adverse visual impact on the landscape, but in the context of an already industrialised area. Some potential for visual impact mitigation through sensitive siting, colouring and detailed building design, including application of principles of good design in accordance with PPS1.
- Positive local effects on long-term employment and enhanced prosperity for local communities.
- The site is not part of a cluster of nominated sites, therefore regional cumulative effects are not considered relevant.

Heysham

S.12.7 The site at Heysham is located in the north-west of England, south of Morecambe Bay, adjacent to the existing Heysham Docks and east of the existing Heysham nuclear power stations. The site occupies an area of drained marsh at the western side of a generally low lying area of land between the River Lune and Morecombe Bay, and is adjacent to residential and industrial areas with grazing land to the east. There are 19 SSSIs within 16km and 10 European protected sites within 20km of the site.

S.12.8 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Adverse effects on three national and internationally protected conservation sites, and on water quality in the region. Possible mitigations include seeking to avoidance the need to disturb sensitive areas where possible; requiring studies to ensure that local groundwater bodies are investigated and suitable design is adopted to avoid or mitigate potential impacts on sensitive habitats/species
- Adverse visual impacts, potentially visible from Lake District National Park, but seen in the context of an already industrialised area. Mitigation possibilities include appropriate landscaping/planting schemes and visual impact mitigation through detailed design, including application of principles of good design in accordance with PPS1. This is, however, limited given the building scale

- Positive local effects on long-term employment and enhanced prosperity for local communities.

- The site at Heysham is approximately 60km south east of the nominated site at Sellafield. The possible, positive regional economic effects discussed above could be enhanced if both the nominated sites in the region were developed.

Hinkley Point

S.12.9 The site at Hinkley Point is located in the south-west of England, on the Severn Estuary and to the west and south of the of the Hinkley Point A and Hinkley Point B nuclear power stations. The site is bounded by the Severn Estuary to the north, the Quantock Hills to the south and west, and the Polden Hills to the east. The surrounding land is predominantly agricultural, and is sparsely populated. There are eight European protected sites within 20km of the site[29]. Located within 5km of the site, to the west and south west, is the Quantock Hills Area of Outstanding Natural Beauty (AONB), which covers 99km, from the Vale of Taunton Deane to the Bristol Channel Coast. The AONB consists of large amounts of heathland, oak woodlands, ancient parklands and agricultural land.

S.12.10 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Adverse effects on protected conservation sites and designated species, including those in the Severn Estuary and Bridgwater Bay. There is the potential for adverse effects on water quality caused by the abstraction and release of cooling water and a risk to fish populations in nearby estuarine/coastal waters. Possible mitigations include ensuring fish protection in cooling water intake design and implementation of a Construction Environmental Management Plan;

- Adverse visual impact on views from an AONB, which would be difficult to mitigate. Possible mitigations include clustering of new and proposed buildings to avoid broadening of the potential visual impact and using existing screening woodland and use of protective buffer zones and application of principles of good design in accordance with PPS1;

- Positive cumulative effects associated with long-term employment and enhanced prosperity in the region;

- The site is in a cluster of two nominated sites in the south west region. Potential regional cumulative effects both positive and adverse may apply if both sites in the region were to be developed; and

- Further significant adverse cumulative effects if both new power stations were to be developed alongside any Severn Tidal Power scheme.

[29] A further two European protected sites – the River Wye SAC and River Usk SAC – were also considered because of hydrological connections even though they are further than 20km.

Oldbury

S.12.11 The site at Oldbury is situated on the southern bank of the Bristol Channel/Severn Estuary in the south west of England. The site is to the north of the existing Oldbury nuclear power station. The south western part of the site comprises silt lagoons (part of the existing nuclear power station site) and the remainder is agricultural land. To the west the site is bounded by the existing flood defences of the Severn Estuary. Some additional infrastructure may be also be required outside the site including additional flood protection measures and cooling water intake and outfall structures, which would extend into the Severn Estuary. There are seven European protected sites within 20km[30] and four scheduled monuments, one registered park and garden (Berkeley Castle), one Conservation Area and 250 listed buildings within an approximate distance of 5km of the site

S.12.12 Potential likely effects and key findings issues recommended as guidance for the IPC to consider include:

- Cooling towers are anticipated owing to insufficient volume of water for direct cooling systems from the river Severn at this location. There would be associated adverse visual impact on two AONB designated landscapes (within 10km of the site), which would be difficult to mitigate. The nominator has stated that its preferred cooling option is a hybrid cooling system which would utilise towers of 70 metres. The scale of the effects would depend upon the eventual size of the cooling towers.

- Adverse effects on five internationally protected conservation sites and three nationally protected conservation sites, and effects on water quality in the region. Possible mitigations include incorporation of fish protection measures within cooling water intake/system design; minimising need for encroachment of construction into sensitive habitat areas through site design; and implementation of a construction Environmental Management Plan to minimise disturbance, for example, through timing of construction programmes, visual/noise screening.

- Positive effects for long term employment and enhanced prosperity for local communities.

- The site is in a cluster of two nominated sites in the south west region. Potential regional cumulative effects both positive and adverse may apply if both sites in the region were to be developed.

- Further significant adverse cumulative effects if both new power stations were to be developed alongside any Severn Tidal Power scheme, the effects of which would be difficult to mitigate.

[30] An eighth European protected site – the River Usk SAC – was also considered because of hydrological connectivity, even though it was further than 20km from the site.

Sellafield

S.12.13 The site at Sellafield is located on the coast in the north west of England, adjacent to the existing Sellafield nuclear facilities and in an established area for the nuclear industry. The site is comprised of agricultural land. The boundary of the Lake District National Park is 1.5km to the east and 5km to the south of the site. The existing Sellafield nuclear facility and infrastructure is a dominant feature of this area of coastline and is visible from the surrounding hills and from the Isle of Man. There are six European protected sites within 20km of the site. Legally protected species within the area include great crested newts, with presence records of natterjack toad, otter, red squirrel and common species of reptile falling within 10km of the nominated site. Nationally important invertebrate species and rare and uncommon plants are also known to occur.

S.12.14 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Adverse effects on three national and internationally protected nature conservation sites, and adverse effects on water quality in the region. Possible mitigations include further water quality studies to determine impacts; water quality monitoring; careful design of the site to avoid entering sensitive areas; and suitable design and location of coastal and fluvial flood defence works and marine landing station

- Low flood risk. Some additional adverse visual impact on the landscape, which may be visible from the Lake District National Park, but this would be in the context of an already industrialised area. Possible mitigations include visual impact mitigation associated with detailed siting of main buildings and application of principles of good design in accordance with PPS1.

- Positive effects associated with long-term employment and enhanced prosperity for local communities.

- Sellafield is approximately 60km north west of the nominated site at Heysham. The possible, positive regional economic effects discussed above could be enhanced if both the nominated sites in the region were developed.

Sizewell

S.12.15 The site at Sizewell is located on the coast adjacent and to the north of the existing Sizewell B nuclear power station near Leiston, Suffolk, in the east of England. The site is on the Suffolk Heritage Coast within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB) and includes part of the Sizewell Marshes SSSI and includes land in the Goose and Kenton Hills. There are 13 European protected sites within 20km of the site.

S.12.16 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Adverse effects on nationally designated landscape areas. The site lies within an AONB and is part of a Heritage Coast. This would be difficult to mitigate.

- Adverse effects on at least five national and internationally protected nature conservation sites; and effects on water quality, and fish/shellfish populations in nearby coastal waters. Possible mitigations include avoidance of need to develop in or disturb sensitive areas; suitable design and location of coastal and fluvial flood defence works and marine landing station; suitable construction methods; and suitable design and location of cooling water abstraction and discharge points

- Positive effects associated with long-term employment and enhanced prosperity for local communities

- The site is not part of a cluster of nominated sites, therefore regional cumulative effects are not considered relevant. However, the potential for adverse effects from Bradwell and Sizewell on the European designated site of the Outer Thames Estuary indicates that there may be interactions and cumulative effects on biodiversity.

Wylfa

S.12.17 The site at Wylfa is located on the north coast of Anglesey, an island off the coast of North Wales, bounded by the Irish Sea. The site is located to the south east and to the east of the existing Wylfa nuclear power station. There are nine European protected sites within 20km of the site[31]. Tre'r Gof SSSI lies within the boundary of the site and this is a rich-fen habitat which supports nationally scarce plants and is considered a representative example of this habitat type within North West Wales. Early indications of legally protected species within 10km of the site include bat species, common species of reptile and choughs[32].

S.12.18 Potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Favourable conditions in terms of coastal flooding, erosion, and dispersion of cooling water;

- Adverse effects on at least four nationally and internationally protected nature conservation sites; possible mitigations include implementation of a Construction Environmental Management Plan to avoid/minimise disturbance to wildlife, to minimise habitat loss and to prevent water pollution; ensuring fish protection in cooling water intake/system design; and avoidance of sensitive areas;

- Significant adverse effects on the local landscapes of an AONB and Heritage Coast;

- Significant beneficial effects for long-term employment and enhanced prosperity for local communities.

[31] A further eight European protected sites were also considered because of hydrological connectivity although they were more than 20km from the site.
[32] The RSPB notes that choughs, an Annex 1 species under the EC Birds Directive, use the headland and fields adjacent to the nominated site

- The site is not part of a cluster of nominated sites, therefore regional cumulative effects are not considered relevant.

Interactions and cumulative effects

S.12.19 Many of the potential impacts and likely significant effects of the revised draft Nuclear NPS for sustainable development are inter-related, particularly between biodiversity, water, climate change, human health, and communities – their social and economic viability including supporting infrastructure and basic services. Cumulative and synergistic effects may arise from the interactions and additions of small insignificant effects and the AoS identified that this was potentially likely where there are clusters of new nuclear power stations. These inter-relationships are considered in the relevant topic sections of the AoS.

S.12.20 The AoS found that these interactions and cumulative effects were more likely to be significant where there are clusters of proposed new nuclear power stations. The AoS recommended that for some areas the revised draft NPS should advise the IPC to consider interactions and cumulative effects if more than one station is built as follows:

- north west of England: Heysham, and Sellafield. The AoSs identified potential beneficial effects of regional significance on employment and community viability, with additional positive effects on health and well-being from secure employment.

- south west of England: Hinkley and Oldbury. The AoSs identified potential interactions and cumulative effects on water quality and on important biodiversity sites in the Severn Estuary and River Wye. Potential positive effects on local employment, upskilling, community viability and health/well-being could be more significant if more than one new nuclear power station is built.

- east of England: Bradwell and Sizewell. The AoSs identified potential interactions and cumulative effects on the important biodiversity site in the Outer Thames Estuary.

Summary of AoS findings

S.12.21 Overall and generally, the AoS identified that the revised draft Nuclear NPS was likely to have significant beneficial effects for energy security of supply and to contribute positively to the Government's targets for a low carbon economy, reducing emissions of greenhouse gases and mitigating the predicted effects of climate change. Significant adverse effects were indicated for internationally important nature conservation sites; the relative significance and effectiveness of mitigation possibilities will be determined at the subsequent project level EIAs and with individual planning applications to the IPC.

S.12.22 At local and regional levels, a combination of likely significant adverse and beneficial effects was identified and their significance depends upon further localised investigations; these will be carried out in more detail with project level EIA studies. Generally, likely adverse effects were associated with capacity of supporting

infrastructure, water, flood risk and biodiversity; likely beneficial effects were associated with long term employment and community viability.

S.13 How did the Appraisal of Sustainability help the development of the revised draft Nuclear National Policy Statement?

S.13.1 The AoS was carried out in an iterative and ongoing way with the development of the revised draft Nuclear NPS. The key recommendations from the AoS were associated with identifying any significant adverse effects and possibilities for mitigation that could help inform the revised draft NPS and its guidance on impacts for the IPC when considering applications for development consent. The AoS also drew attention to the potential for cumulative effects where there might be clusters of new nuclear power stations, particularly in the north west and south west of England.

S.14 Monitoring

S.15 How will we monitor the likely effects of the energy National Policy Statements?

S.14.1 Monitoring helps to examine the predicted effects of the NPS (identified through the AoS process) against the actual effects of the NPS when it is implemented e.g. when infrastructure is constructed and operating. It is not necessary to monitor everything or monitor a predicted effect indefinitely. The purposes is to monitor the significant, predicted and actual effects, and to identify any unforeseen effects.

S.14.2 The Government has published a draft monitoring strategy for public consultation which covers all the energy NPSs including nuclear[33]. As ENs-1-5 are not spatially specific and therefore the precise location, type and quantity of proposed energy infrastructure developments that will be granted development consents or licences to operate, is not known. Accordingly there are a wide range of potential effects that may occur and that will depend on a number of factors, including the speed and proportion of infrastructure development that is successfully developed across the range of energy sectors and the application of mitigation measures as set out in the NPSs. Monitoring is, therefore, most effectively focused on environmental and socio-economic trends. At a strategic level the lack of spatial definition means that it may not be possible to attribute changes (improvements or deterioration) in trends directly to any one individual NPS.

S.14.3 The Government proposes to make use of existing monitoring where possible. Key possible indicators/measures for monitoring the sustainability effects of the Nuclear NPS could include[34]:

- the condition of European Sites and SSSIs identified as potentially affected by development;

[33] www.energynpsconsultation.decc.gov.uk
[34] This is not an exhaustive list. See the draft monitoring strategy for more details.

- Emissions of air pollutants (nitrogen oxides (NOx), sulphur dioxide (SOx), particulates (PM_{10}); and
- Areas at risk of flooding (fluvial, groundwater, sea level rise).

S.16 Next steps

S.15.1 The revised draft Nuclear NPS, the revised AoS and the HRA Reports are subject to public consultation for 14 weeks from the date of publication. Details of how to submit comments are set out in the Consultation Document. All documents are available from the Department of Energy and Climate Change's consultation website www.energynpsconsultation.decc.gov.uk

S.15.2 The Government will consider comments received during the public consultation, and the Nuclear NPS will be subject to ratification by Parliament before final designation. Upon designation of the Nuclear NPS, an AoS Statement will be published and this will outline how the findings of the AoS and the responses to consultation have been taken into account. It will also provide further information on how monitoring will be carried out.

Background to the NPS and AoS

Chapter 1. The revised draft Nuclear National Policy Statement

1.1 The Planning Act 2008 and National Policy Statements

1.1.1 The Government wants a planning system for major infrastructure which is rapid, predictable and accountable. Planning decisions should be taken within a clear policy framework making these decisions as predictable as possible. The final energy National Policy Statements (NPSs) will be a blueprint for decision-making on individual applications for development consent for the relevant types of infrastructure. The final energy NPSs will clearly set out Government's policy insofar as it relates to planning applications for major energy infrastructure and will give investors the certainty they need to bring forward proposals to maintain security of supply and ensure progress towards decarbonisation.

1.1.2 In line with the Planning Act 2008, the revised draft energy NPSs are drafted on the basis that once they are designated the Infrastructure Planning Commission (IPC) will be the decision making body. The Government announced in June 2010 its intention to amend the Planning Act 2008 and abolish the IPC. In its place, the Government envisages that a Major Infrastructure Planning Unit (MIPU) will be established within the Planning Inspectorate. Once established, the MIPU would hear examinations for development consent and would then make a recommendation to the Secretary of State. It would not itself determine applications; decisions would be taken by the relevant Secretary of State.

1.1.3 These proposed reforms require primary legislation. Until such time as the Planning Act 2008 is amended, the IPC will continue as set out in that Act. As a result, the NPSs will provide the framework for decisions by the IPC on applications for development consent for major infrastructure projects, and under the new arrangements will provide the framework for recommendations by the MIPU to the Secretary of State.

1.2 The energy National Policy Statements

1.2.1 The Department of Energy and Climate Change (DECC) is responsible for preparing the NPSs that relate to energy infrastructure projects. The revised Overarching Energy NPS (EN-1) sets out the need, high level objectives, policy and regulatory framework for new energy infrastructure consistent with sustainable development and addressing climate change. There are a further five technology specific NPSs as follows:

- EN-2 Fossil Fuel Electricity Generating Infrastructure;

- EN-3 Renewable Energy Infrastructure;
- EN-4 Gas Supply Infrastructure and Gas and Oil Pipelines;
- EN-5 Electricity Networks Infrastructure;
- EN-6 Nuclear Power Generation.

1.2.2 These six NPSs provide the planning policy for the IPC when it is considering applications for nationally significant energy infrastructure. They establish the need for such development and direct the IPC as to how to assess the impacts of major energy infrastructure. Developers will need to ensure that their applications for development consent are consistent with the requirements of the relevant NPSs. The IPC will also take into account local impact reports prepared by local authorities. The Nuclear NPS is different from the other energy NPSs because it includes a list of potentially suitable sites for new nuclear power stations. The revised draft Nuclear NPS is the subject of this Appraisal of Sustainability (AoS).

1.2.3 The final Nuclear NPS will only have effect in relation to applications for new nuclear development at one of the listed sites. In the event that a developer submits an application for development consent on a site not listed in the final Nuclear NPS, the application would be examined by the IPC who would make a recommendation to the Secretary of State.

1.2.4 EN-1 sets out at a strategic level Government policy with a framework for consenting planning decisions of major energy infrastructure , including policies to address security of supply and the reduction of carbon emissions, the need for new generating capacity and a mix of technologies. This will allow the IPC to concentrate on the potential impacts of the development at the proposed location(s), and whether applications should be granted consent. EN-1 provides assessment principles for the IPC in dealing with generic impacts of development; the technology specific NPSs provide guidance on impacts that are particular to individual technology types. The revised draft Nuclear NPS should be read in conjunction with the revised draft EN-1.

1.3 The revised draft Nuclear National Policy Statement

1.3.1 Together with EN-1, the revised draft Nuclear NPS sets out the Government's policy on the national strategic issues which need to be taken into account when granting consent for the construction of new nuclear power stations.

1.3.2 The main objective of the revised draft Nuclear NPS is to provide the primary basis for planning decisions by the IPC on applications for development consent for a new nuclear power station. It sets out the role of nuclear power and the planning policy in which applications for new nuclear power stations should be considered in accordance with. It lists the sites nominated as part of the Strategic Siting Assessment (SSA) which have been assessed to be potentially suitable for the deployment of new nuclear power stations by the end of 2025[35].

[35] As set out in the Planning Act 2008, a NPS may identify one or more locations as suitable (or potentially suitable) or unsuitable for a specified description of development. For the purposes of this document, "deployment of new nuclear power stations" means commencing operation of one or more new nuclear power stations on the site.

1.3.3 The revised draft Nuclear NPS has been developed using a SSA process for identifying potentially suitable sites for deployment of new nuclear power stations by 2025. The early stage of the NPS development included preparing exclusionary and discretionary criteria to be used in the SSA process, in consultation with regulators, technical specialists and the public. The SSA process was also subject to an AoS[36] and a Habitats Regulations Assessment (HRA)[37] screening as part of the overall development of the revised draft Nuclear NPS and these reports were included in the consultation processes.

1.3.4 Nominations to develop sites were invited and these nominations were assessed against the conditions of nominating and the SSA criteria. Eleven nominated sites[38] were assessed against exclusionary criteria and discretionary criteria. These eleven sites also underwent appraisal through the AoS and HRA process. The Government also commissioned an Alternative Sites Study[39] to identify any other sites which might be potentially suitable.

1.3.5 As a result of the SSA process, the Government concluded that ten sites were potentially suitable for deployment of new nuclear power stations by the end of 2025[40] and these were included in the initial draft Nuclear NPS for public consultation in November 2009. As a result of the representations received during the public consultation and having considered deployability by the end of 2025 and the impact on areas of amenity, cultural heritage and landscape value (including the Lake District National Park), the Government has now concluded that the nominated sites at Braystones and Kirksanton are not potentially suitable. The Government has also confirmed that Dungeness is not potentially suitable. Therefore, the revised draft Nuclear NPS sets out a list of eight sites that are potentially suitable for deployment by 2025. This list of eight sites (Figure 1.2) is part of the current Government consultation on the revised draft Nuclear NPS.

1.3.6 New nuclear power stations may have negative and positive impacts on the environment and local communities. The significance of these impacts depends upon the characteristics of the local area and the detailed design of the nuclear power station. Under the new planning regime, the developer will still need to provide an Environmental Statement to accompany their application for development consent. Any new nuclear power station will still be subject to safety licensing conditions and the operator will have to comply with the safety and environmental conditions set by the regulators.

1.3.7 The revised draft NPS sets out guidance for the IPC, including the general principles that should be applied in the assessment of impacts, and advises on the impacts from new nuclear power stations that are likely to have the most significant effect on sustainable development. The outline contents of the revised draft Nuclear NPS are as follows:

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[36] BERR (July 2008) *Applying the proposed Strategic Siting Assessment Criteria: A study of the potential environmental and sustainability effects*.
[37] BERR (July 2008) *Habitats Regulations Assessment Screening Report*
[38] The eleven nominated sites were Bradwell, Braystones, Dungeness, Hartlepool, Heysham, Hinkley Point, Kirksanton, Oldbury, Sellafield, Sizewell and Wylfa.
[39] Atkins Ltd for DECC (2009) *A consideration of alternative sites to those nominated as part of the Government's Strategic Siting Assessment process for new nuclear power stations*, http://data.energynpsconsultation.decc.gov.uk/documents/atkins.pdf
[40] Dungeness was assessed as not potentially suitable.

- Part 1 is an introduction and context to the revised draft NPS;
- Part 2 sets out assessment principles, consideration of alternatives, regulatory justification, the relationship between the planning regimes and the regulatory framework, and the role of the IPC when considering proposals that include facilities to manage radioactive waste;
- Part 3 sets out impacts and general siting considerations;
- Part 4 lists the potentially suitable sites;
- Annex A sets out the Imperative Reasons of Overriding Public Interest for the revised draft Nuclear NPS;
- Annex B sets out the rationale for why the Government is satisfied that effective arrangements will exist to manage the radioactive waste which new nuclear power stations will produce; and
- Annex C of the NPS sets out an analysis for each site detailing the assessment of the site against the SSA criteria, and highlighting particular issues that were raised in the assessment and may need to be considered for development consent and site licensing. This will help scope the information that needs to be provided in the Environmental Statement[41] and should speed up the decision-making process for building new nuclear power stations.

1.3.8 A key characteristic of nuclear power stations is the requirement to manage radioactive waste. The Government considers that it is technically possible and desirable to dispose of new higher activity radioactive waste in a geological disposal facility and that this would be a viable solution and the right approach for managing waste from any new nuclear power stations. The Government considers that waste can and should be stored in safe and secure interim storage facilities until a geological disposal facility (GDF) becomes available.

[41] To be prepared by developers prior to submission of a development consent application to the IPC.

Figure 1.2 Potentially suitable sites

Chapter 2. The AoS process and methods

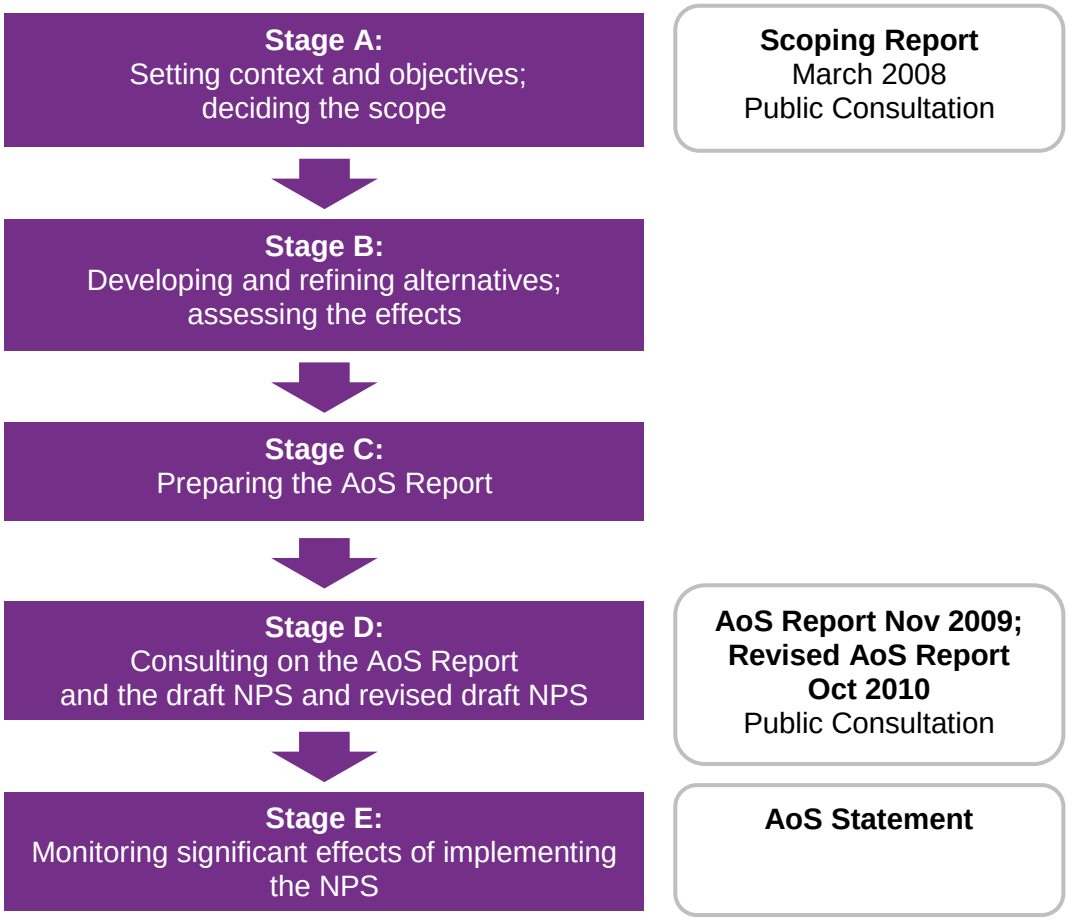
2.1 Overview of the Appraisal of Sustainability process and other assessments

Appraisal of Sustainability

2.1.1 The Planning Act 2008, (Section 5 (3)) requires that *"…an appraisal of the sustainability of the policy set out in the statement*" must be carried out before a statement can be designated as a NPS. The main purpose of an AoS is to examine the sustainability effects of the developing NPS and provide decision makers, consultees and others with information on the wider effects of future development.

2.1.2 The approach to this AoS was modelled on the Government's guidance for preparing SEAs and Sustainability Appraisals, as there is no guidance yet on preparing an AoS. This is a staged approach as outlined in the following figure:

Figure 2.1: Stages of AoS (incorporating SEA)



Strategic Environmental Assessment

2.1.3 This appraisal incorporates an assessment in accordance with the requirements of the European Strategic Environmental Assessment Directive[42] (the "SEA Directive") and the transposing Regulations in the UK. The SEA Directive aims for a high level of environmental protection and to promote sustainable development. It applies to certain plans and programmes that are likely to have a significant effect on the environment. SEA helps inform the preparation of plans by identifying and examining the potential significant effects of the plan on the environment.

2.1.4 Social and economic factors are considered in an AoS in a similar manner as environmental factors in SEA, aiming to integrate social, economic and environmental aspects to better promote sustainable development. The integrated appraisal reported in this document is an AoS incorporating the requirements of the SEA Directive and will be referred to throughout the report as an AoS.

Environmental Impact Assessment

2.1.5 The environmental assessment process continues from the strategic level SEA of plans and programmes to the project level Environmental Impact Assessment (EIA). Under the new planning regime, developers will still have to submit an Environmental Statement reporting the EIA with their application to the IPC for development consent. EIA is a process that provides information to planners, other regulators and the public about certain proposed developments and their likely effects on the environment. By integrating the EIA process and the emerging design of a development as early as possible, potential adverse impacts can be best mitigated and opportunities for environmental enhancement optimised.

Habitats Regulation Assessment

2.1.6 The revised draft Nuclear NPS has also been assessed in accordance with the European Habitats Directive. The main aim of the European Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The AoS was carried out at the same time as the HRA and was informed by emerging findings. The HRA and the AoS are presented as two separate reports to make the technical information manageable and more readily accessible.

[42] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment

Consultation

2.1.7 Consultation is an important part of the assessment processes. It is a requirement of the SEA Directive that authorities with specific environmental responsibilities should be consulted on the scope of the SEA. During the development of the AoS there has been ongoing consultation and liaison with these statutory bodies and other bodies with a regulatory or advisory role in relation to nuclear facilities and their development[43].

2.1.8 It is also a requirement[44] of the SEA Directive that these bodies and the public are given an effective opportunity to comment on the draft Nuclear NPS and the accompanying report, which in this case is an AoS Report (incorporating an Environmental Report in accordance with the SEA Directive). This consultation stage is further explained at the end of this chapter in section 2.6 and includes next steps on how the Government will address the comments received.

2.2 Developing the Appraisal of Sustainability

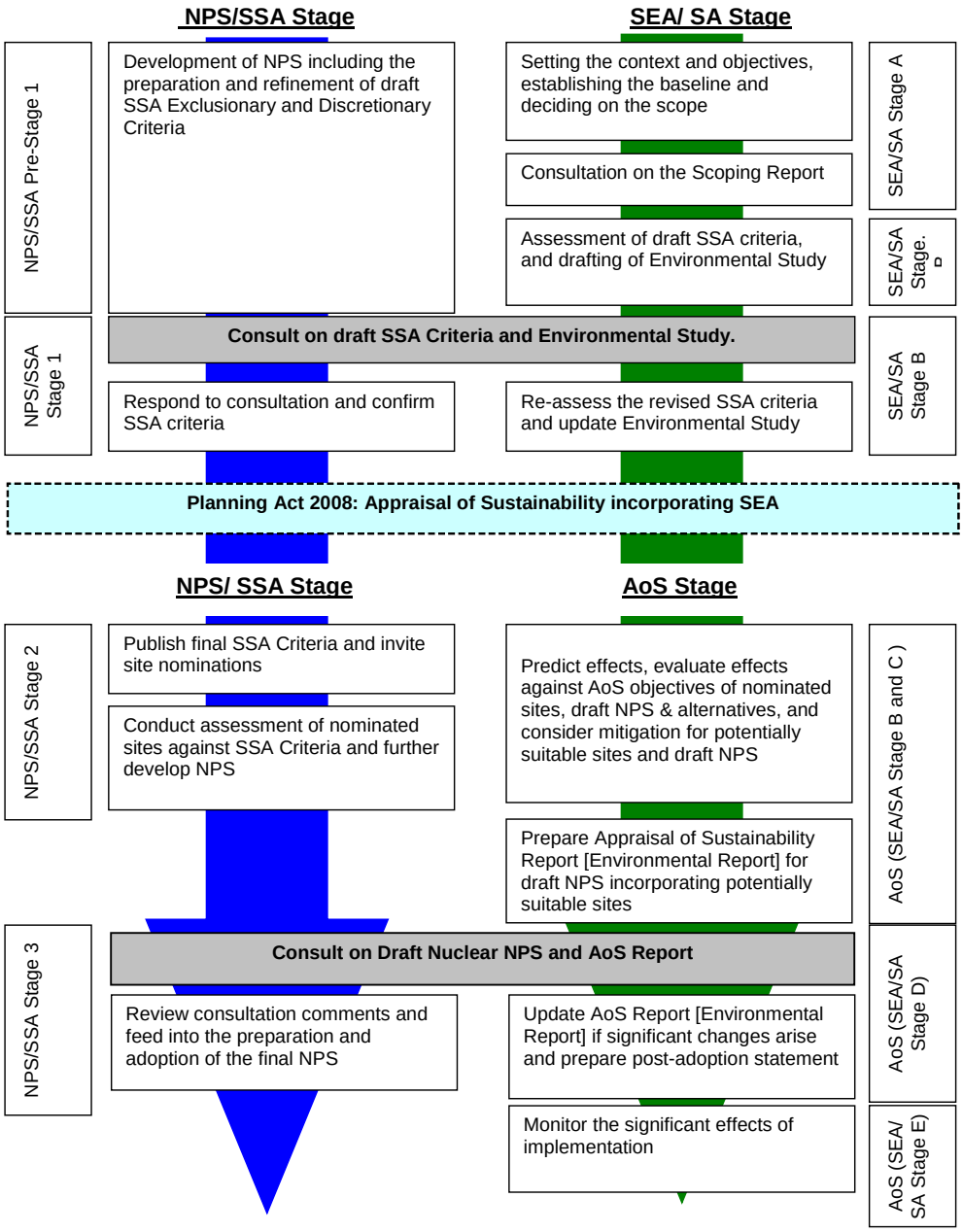
2.2.1 The Government began the process leading to the preparation of the revised draft Nuclear NPS before the implementation of the Planning Act in 2008 and the requirement for an AoS. However, the process anticipated the emerging planning reforms and from the outset the appraisal considered social and economic factors as well as those environmental factors that are likely to be addressed through SEA. The revised draft Nuclear NPS is different from the other draft Energy NPSs as it includes both national policy and a list of sites that have been assessed as potentially suitable for building new nuclear power stations that could be in operation by the end of 2025.

2.2.2 Also from the outset, the process leading to the preparation of the Nuclear NPS proposed an integration of plan making and the appraisal processes. The SSA process for identifying potentially suitable sites is based on criteria that were scoped as appropriate for a Nuclear NPS. The SSA criteria were subject to appraisal using the AoS framework of objectives for sustainability. The roles and interactions of the process of developing the revised draft Nuclear NPS, including the SSA, and the AoS process, are set out in Figure 2.2.

[43] The bodies consulted in the preparation of this AoS were Countryside Council for Wales, Cadw, Environment Agency Wales, Natural England, Environment Agency, English Heritage, Scottish Natural Heritage, Scottish Environment Protection Agency, Historic Scotland and Department of the Environment Northern Ireland, the Department of Health, Health Protection Agency, Nuclear Installations Inspectorate and Defra.

[44] "The authorities [with relevant environmental responsibilities] and the public…shall be given an early and effective opportunity within appropriate timeframes to express their opinion on the draft plan or programme and the accompanying environmental report before the adaptation of the plan or programme." (SEA Directive Article 6 (2))

Figure 2.2: Roles and interactions: AoS, SSA, and NPS



2.2.3 Thus the AoS has been developed through a number of stages that reflect consultation responses and changes in legislation and guidance. The key steps in the development of the process so far are set out in Table 2.1:

Table 2.1: Key steps in developing the AoS

AoS Development	Purpose
Consultation on The SEA Scoping Report[45] (March 2008)	A report comprising early consultation with the statutory bodies and other interested parties on the scope and level of detail proposed for the SEA (now AoS) in accordance with the SEA Directive.
The Environmental Study and Sustainability Study[46] (July 2008)	As part of the consultation on the proposed SSA criteria, This comprised a study of the potential environmental and sustainability effects of applying the SSA criteria.
The Update Report[47] (January 2009)	A report to update the environmental study with changes made to the SSA criteria as a result of consultation. Also explains changes from an SEA to an AoS in accordance with new requirements outlined in the Planning Act 2008.
Ongoing consultation during appraisal stage (April – November 2009)	Liaison with statutory environmental bodies, relevant regulators, and other Government departments to assist with refinement of AoS methods and assessments.
Initial AoS Report[48] (November 2009)	Meeting the requirements of the Planning Act 2008 for AoS and incorporating the requirements of the SEA Directive The AoS Report comprised: • Non Technical Summary • Main AoS • Sites AoS Consultation with statutory consultees; publication on DECC website
This revised AoS Report (October 2010)	Following public consultation, responses considered; draft NPS and AoS revised. The revised AoS Report meets the requirements of the Planning Act 2008 for AoS and incorporating the requirements of the SEA Directive. The revised AoS Report comprises a Non-Technical Summary, Main AoS and Sites AoSs. Publication of revised AoS together with revised draft NPS on DECC website for consultation.
AoS Statement	Following consultation on the revised draft Nuclear NPS and the AoS Report, this final AoS Statement will set out how the consultation and the appraisal have been taken into account in deciding the final NPS to be designated.

[45] BERR (March 2008) *Consultation on Strategic Environmental Assessment for proposed National Policy Statement for new nuclear power*, URN 08/680QAN, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45240.pdf
[46] BERR (July 2008) *Applying the Proposed Strategic Siting Assessment Criteria: A study of the potential environmental and sustainability effects*, URN08/962, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file47137.pdf
[47] DECC (Jan 2009) *Applying the Strategic Siting Assessment Criteria: an update to the study of the potential environmental and sustainability effects http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file49869.pdf*
[48] DECC (Nov 2009) *Appraisal of Sustainability of the draft Nuclear National Policy Statement* http://data.energynpsconsultation.decc.gov.uk/documents/aos/mainreport.pdf. This incorporated an Environmental Report in accordance with the European SEA Directive 2001/42/EC

2.3 Scoping

- *Identifying other relevant policies, plans, programmes, sustainability objectives*
- *Collecting baseline information*
- *Identifying key sustainability issues*
- *Developing relevant objectives, indicators and targets*
- *Consulting on the proposed scope of the AoS*

2.3.1 The SEA Scoping Report was[49] published in March 2008 and set out the proposed scope of the SEA with additional socio-economic topics in anticipation of the implementation of the Planning Act in 2008 and the requirement for AoS. The subsequent change in terminology does not imply any change in the scope of the environmental and sustainability assessments since the AoS incorporates an SEA.

2.3.2 The Scoping Report set out the proposed framework for appraisal including:

- background and outline of the proposed draft Nuclear NPS;
- geographical scope: UK (policy); England and Wales (sites);
- main elements of the developing NPS to be appraised: SSA criteria and sites;
- baseline information against which the appraisal would be carried out and policy context;
- topics to be considered;
- framework of AoS objectives, decision-aiding questions and possible indicators for monitoring; and
- methods of assessment, including approach and definitions of certainty, nature, timescales, and spatial extent for assessing the SSA criteria.

2.3.3 The scope of this AoS was identified through analysis of relevant baseline information, the policy context, the relevance to the developing draft NPS and the responses to the public scoping consultation in March 2008. The appraisal itself was carried out using a set of sustainability objectives as a way of identifying and evaluating the potential significant effects of the draft NPS on communities and the environment. These objectives for appraisal, organised into topics and themes for sustainable development, were developed through consideration of the plans and programmes relevant to the revised draft Nuclear NPS, the requirements of the SEA Directive, and the responses to scoping consultation (see following tables 2.2, 2.3, 2.5).

2.3.4 The detailed review of relevant plans, programmes and environmental protection objectives at international and national levels for each topic was set out in Appendix A of the Scoping Report (March 2008). This considered the key objectives of the

[49] BERR (March 2008) *Consultation on Strategic Environmental Assessment for proposed National Policy Statement for new nuclear power*, URN 08/680QAN, http://www.berr.gov.uk/files/file45240.pdf

relevant plan or programme, any key targets and/or indicators, and how the environmental and sustainability objectives related to the development of the draft NPS and the AoS. The plans and programmes included European directives and UK national plans relating to sustainable development topics and environmental protection objectives. Relevant key strategic plans and programmes include the following[50]:

- Habitats Directive (1992), Birds Directive (1979), Ramsar Convention (1971), UK Biodiversity Action Plan (1994) *(SEA topic: biodiversity, fauna, flora)*
- Convention on Nuclear Safety (1994), EURATOM Directive protecting health from ionising radiation (1996), UK Egan Review (2004), Sustainable Communities (2003) *(SEA topics: population, human health)*
- Soil Strategy for England (2009) *(SEA topic: soil)*
- Water Framework Directive (2000), UK Water Resources Strategy (2001), UK Strategy for Flood & Coastal Erosion Risk Management (2005) *(SEA topic: water)*
- Kyoto Protocol (1997), Air Quality Framework Directive (1996), UK Climate Change Act (2008) UK Climate Impacts Programme (2009) *(SEA topics: Air, climatic factors)*
- Hazardous Waste Directive (1991) *(SEA topic: material assets)*
- UK Historic Environment (2001) (SEA topic: cultural heritage)
- UK protected landscapes: National Parks, Areas of Outstanding National Beauty, historic coasts *(SEA topic: landscape)*
- Integrated Pollution Prevention & Control Directive (1996), OSPAR Radioactive Substances Strategy, UK Sustainable Development Strategy (2006) *(SEA topics: interrelationships)*
- Aarhus Convention (1998) (SEA consultation)
- River Basin Management Plans
- Renewable Energy projects

2.3.5 The key policy context for each topic is discussed in section 2 of the relevant appendix (A1-A11) at the strategic level. The key policy context for each site is set out in section 3 of each Site AoS Report (Annexes A-H) for the regional and local levels. The scope of the AoS considered the environmental, social and economic effects of the revised draft Nuclear NPS. The UK Sustainable Development (SD) Strategy (2005) sets out five guiding principles to help achieve sustainable

[50] This is not an exhaustive list. Further details about relevant plans and programmes can be found in BERR (March 2008) *Consultation on Strategic Environmental Assessment Scoping Report for Proposed National Policy Statement for New Nuclear Power – Appendices and Figures*, URN 08/680AN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45241.pdf and BERR (July 2008) *Applying the proposed Strategic Siting Assessment Criteria: a study of the potential environmental and sustainability effects – Appendices,* URN 08/926ANN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file47140.pdf

development, the goal of which is defined as "*to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life of future generations*." The Strategy further identifies four priority areas for immediate action: sustainable consumption and production; climate change and energy; natural resource protection and environmental enhancement; and sustainable communities.

2.3.6 Detailed baseline data at international and national levels was set out for each relevant topic in Appendix B of the Scoping Report (March 2008)[51] and included baseline trend data where available. Baseline data at regional and local levels for each potentially suitable site for new nuclear power stations is provided in Appendix 4 to each Site AoS report (Annexes A-H) and informed the characterisation for each site described in section 4 of each Site AoS Report. This is also set out according to relevant topics and provides the baseline against which the appraisals were carried out.

2.3.7 Key issues and opportunities for sustainability were detailed in Appendix C of the Scoping Report (March 2008). Key considerations identified included noting that many internationally designated sites for biodiversity are located in estuarine and coastal locations – new nuclear power stations are likely to be at coastal locations for cooling water abstractions and discharges, and that the new stations will add to the legacy of radioactive waste.

2.3.8 Characterisations of the current situation for each topic are detailed in section 4 of each topic appendix (1-11) and also includes consideration, where possible, of the likely evolution of this baseline condition without the implementation of the revised Nuclear NPS. At each of the eight potentially suitable sites, if new nuclear power stations were not developed, it is uncertain what infrastructure (if any) might be developed at that site. The current situation and key issues for sustainable development and the revised draft Nuclear NPS may be summarised by SD theme as follows:

- *Climate Change*: The climate of the UK is changing and increased emissions of greenhouse gases (GHGs) from human activities into the atmosphere is widely recognised as one of the main contributors to global warming. Climate change represents a significant risk to ecosystems, the economy and human populations and could lead to a number of significant changes to environmental conditions. These changes are likely to exacerbate current environmental trends across the UK, such as the continued loss of natural habitats and biodiversity and increased pressure on water resources. The Government is committed under the Kyoto Protocol to reduce emissions of GHGs by 12.5% below 1990 levels by 2012.

- *Biodiversity*: The UK Government's commitment to the Convention on Biological Diversity (1992) is delivered through the UK Biodiversity Action Plan that aims to contribute to a significant reduction of the current rate of biodiversity loss. The Government has set a target for 95% of land and sea features designated in the UK as SSSI, SPA or SAC to be in either favourable

[51] BERR (March 2008) *Consultation on Strategic Environmental Assessment Scoping Report for Proposed National Policy Statement for New Nuclear Power – Appendices and Figures*, URN 08/680AN http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file45241.pdf

or recovering by 2010. As of 2008, the conditions of features were below the target at generally between 60% and 80%.

- *Sustainable Communities*: The Egan Review (2004) sets out key objectives for ensuring that opportunities to access employment are considered. In certain areas road traffic is already at high stress levels and is predicted to grow for a variety of reasons, but typically as a result of general development. UK transport policy is designed to encourage more sustainable travel choices. Waste in the UK continues to grow but national policy continues to focus on the waste hierarchy in order to reduce waste and improve the efficient use of resources. The security of energy supplies in the UK is a major issue.

- *Health*: The Index of Multiple Deprivation (IMD) shows that the south east and east of England are the least deprived areas in the UK. Generally, areas of health concerns relate to increasing levels of obesity and geographical inequalities in the UK. Other key issues for energy infrastructure include the suitability of housing and the extent of fuel poverty. The increase of life expectancy contributes to the demand for electricity. The importance of access to open space for recreational activities is recognised by the Government in current planning policy. The UK has a strict regulatory regime to protect people and the environment with regard to radiological (nuclear) factors.

- *Cultural Heritage and Landscape*: Important landscape, cultural and historic features are protected in the UK and it was noted that loss of the heritage resource is difficult to mitigate. Generally across Europe there is a recognition that landscape diversity and quality is deteriorating. In the UK, areas where landscape character is neglected are generally close to major population and transport routes.

- *Air Quality*: in the UK air quality has generally improved since 1997 when the first Air Quality Strategy was adopted. One of the dominant sources of sulphur dioxide in the UK is power generation from the burning of fossil fuels; the largest source of nitrogen oxide is traffic. Compared to fossil fuel generating stations, nuclear power stations do not emit significant quantities of carbon dioxide, sulphur dioxide, nitrogen oxides or particulates.

- *Soils and Geology*: The EU has proposals for a Soil Framework Directive (2007) that aims to prevent further degradation of soil and preserve its functions. Soils, geology and the use of land are protected by various policies in the UK.

- *Water Quality and Resources; Flood Risk*: Water includes consideration of environmental and human health protection and the sustainable use of resources; all aspects of water are interconnected and often interact with other factors such as biodiversity. The EU Water Framework Directive (2000) aims to prevent further deterioration of aquatic ecosystems and associated wetlands. The UK Water Strategy (2008) aims to improve the water environment and ensure sustainable water management. Generally water quality in the UK is expected to increase or remain unchanged and fit with the target to achieve good ecological status by 2027. Increases in population coupled with the predicted effects of climate change will increase pressure on water resources and increase flood risk. The UK Strategy for Flood and Coastal Erosion Risk

Management (2005) provides key policy context on managing risk and increasing resistance and resilience. Large parts of England are at risk from flooding from rivers and the sea. About 5 million people live in floodplains or areas identified as being at risk of coastal flooding in England and Wales.

2.4 Alternatives and assessing effects

- *Developing the draft NPS strategic alternatives*
- *Predicting the effects of the draft NPS, including alternatives*
- *Evaluating the effects of the draft NPS, including alternatives*
- *Considering ways of mitigating adverse effects*
- *Proposing measures to monitor the significant effects of implementing the NPS*

2.4.1 This second stage of the appraisal process involved identifying, describing and evaluating the potential significant effects of the developing draft Nuclear NPS. Consideration was given to possibilities for mitigating significant adverse effects. The methods of appraisal were refined as both the draft NPS and the AoS were developed, including identifying the appropriate levels of detail for each element of the emerging draft NPS, and in ongoing consultation with the statutory bodies for SEA.

AoS objectives for Sustainable Development

2.4.2 The SEA Directive suggests a range of topics for assessing a plan including biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage, landscape and the inter-relationships between these factors. All these topics have been considered in appraising the revised draft Nuclear NPS. The AoS objectives for these topics were grouped into Sustainable Development (SD) themes to help with appraising different aspects of the emerging draft NPS. The AoS objectives used were as shown on Table 2.2.

Nature and significance of effects

2.4.3 Often topics are inter-related, for example, changes to transport types and routes can affect emissions of carbon dioxide that contribute to the effects of climate change. This may subsequently affect biodiversity and the risk of flooding. Secondary or indirect effects may occur as a result of a complex pathway between an activity, such as building flood defences, and the sensitivity of the receiving environment. For example, the flood defences may change movements of sediments and thus affect the ecology of a nearby wetland.

Table 2.2: Sustainable Development themes and AoS objectives

Sustainable Development Theme/AoS Objective (The SD Themes are shown in bold text in grey boxes and the AoS Objectives are shown in normal text in white boxes beneath their Theme. Numbers in brackets refer to the numbers given to the Objectives in the SEA Scoping Report March 2008)
SD Theme: Climate Change (Mitigation)
• to minimise greenhouse gas emissions (13)
SD Theme: Biodiversity and Ecosystems
• to avoid adverse impacts on the integrity of wildlife sites of international and national importance (1)
• to avoid adverse impacts on valuable ecological networks and ecosystem functionality (2)
• to avoid adverse impacts on Priority Habitats and Species including European Protected Species (3)
SD Theme: Communities – population, employment, and viability
• to create employment opportunities (4)
• to encourage the development of sustainable communities (5)
• to avoid adverse impacts on property and land values and avoid planning blight (10)
SD Theme: Communities – supporting infrastructure
• to avoid adverse impacts on the function and efficiency of the strategic transport infrastructure (8)
• to avoid disruption to basic services and infrastructure (9)
SD Theme: Human Health and Well-Being
• to avoid adverse impacts on physical health (6)
• to avoid adverse impacts on mental health (7)
• to avoid the loss of access and recreational opportunities, their quality and user convenience (11)
SD Theme: Cultural Heritage
• to avoid adverse impacts on the internationally and nationally important features of the historic environment (22)
• to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes (23)
SD Theme: Landscape
• to avoid adverse impacts on nationally important landscapes (24)
• to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness (25)
SD Theme: Air Quality
• to avoid adverse impacts on air quality (12)

SD Theme: Soils, Geology, Land Use
• to avoid damage to geological resources (19)
• to avoid the use of greenfield land and encourage the re-use of brownfield sites (20)
• to avoid the contamination of soils and adverse impacts on soil functions (21)
• to avoid damage to geological resources (24)
SD Theme: Water Quality and Resources
• to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology) (15)
• to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives (16)
• to avoid adverse impacts on the supply of water resources (17)
• to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives (18)
SD Theme: Flood Risk
• to avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible (14)
Radioactive and associated hazardous waste is cross-cutting and has the potential to affect many of the above objectives for sustainable development. As this topic is unique to new nuclear power stations, consideration of the likely significant effects is dealt with as a separate chapter in the AoS
Sub-objectives (guide questions) were identified through the scoping process for each of the above AoS objectives. These more specifically define each objective and help to avoid duplication for cross-cutting issues during the appraisal. The guide questions are set out in Table 2.8 which also demonstrates the compatibility between the AoS frameworks for the Overarching and other draft Energy NPSs and the draft Nuclear NPS (see Section 2.5)

2.4.4 Cumulative effects arise, for example, where several developments each have insignificant effects but together have a significant effect; or where several individual effects have a combined effect. Synergistic effects interact to produce a total effect greater than the sum of the individual effects. For example, a wildlife habitat can become progressively fragmented with limited effects on a particular species until the last fragmentation makes the area too small to support the species. Beneficial cumulative effects may occur with several developments in a sub-region; collectively they reach a threshold for employment and other supporting infrastructure such that the communities become more sustainable.

2.4.5 The potential effects of the revised draft Nuclear NPS may be positive or negative and where potential significant adverse effects were identified, mitigation measures have been suggested. Each topic was appraised using professional judgment and available information. Any gaps in information or uncertainty about the appraisal have been recorded. Outline proposals for monitoring the predicted effects have been suggested for when the NPS is designated.

2.4.6 The nature and significance of predicted potential effects were recorded with commentary in matrices using symbols and colours with a grading system as shown on Table 2.3.

Geographical and temporal scope of the AoS

2.4.7 The revised draft Nuclear NPS lists sites in England and Wales which are potentially suitable for the deployment of new nuclear power stations by the end of 2025. Therefore the focus of the AoS was on the effects associated with England and Wales, although consideration was given to any significant effects for the rest of the UK and any significant transboundary effects. It was concluded that significant transboundary effects are unlikely[52]. The revised draft Nuclear NPS and its accompanying AoS and HRA reports have been sent to EU Member States for information.

2.4.8 The revised AoS includes appraisal of both the effects of the whole revised draft NPS and the specific effects of potentially suitable sites. Generic design characteristics for new nuclear power stations were considered for the appraisal since the detailed design will be addressed at the project EIA stage. This is set out in more detail later in Table 2.6. The timescales for appraisal were as follows:

- construction - 5-6 years;
- operation - approximately 60 years;
- decommissioning - minimum 30 years;
- interim waste storage on site - approximately 100 years after the end of operation; and
- lifetime of site: around 166 years[53] (6+60+100 years).

[52] See Chapter 7 for conclusions on significant transboundary effects

[53] The site lifetime of 166 years assumes 6 years for construction, 60 years for operation and 100 years for interim storage of spent fuel after the last defueling. It is possible to envisage a scenario in which onsite interim storage might be required for around 160 years from the start of the power station's operation, to enable an adequate cooling period for fuel discharged following the end of the power station's operation. In making its assessment that onsite interim storage might be needed for 160 years, the Government took a conservative approach, to ensure that local communities are aware that it is possible that onsite interim storage might be required for this length of time. Following the public consultation, the Government has revised its position. The Government recognises that onsite interim storage might be required beyond 2130, particularly in the event that a GDF is not available to take the waste, but the Government does not expect onsite interim storage to be required for as long as 160 years. Further detail is set out in The Government Response to the consultation on the draft National Policy Statements for Energy, DECC, 2010, www.energynpsconsultation.decc.gov.uk

Table 2.3: Significance and categories of potential strategic effects

Key: Significance and Categories of Potential Strategic Effects		
Major positive	++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
Minor positive	+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
Neutral	0	Neutral effect
Minor Negative	-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
Major Negative	--	Problematical because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/international significance
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 the symbol?

The Environmental and Sustainability Study - July 2008

2.4.9 As part of the consultation on the Strategic Siting Assessment (SSA) process, the Government sought views on the proposed SSA criteria. A study was undertaken to assess the potential environmental and sustainability effects of siting in accordance with the proposed criteria against the 25 objectives for sustainability agreed through the scoping process. The study considered how each proposed SSA criterion might affect sustainability objectives as follows:

- background;
- overview of potential impacts for each phase of nuclear power activity: construction, operation and decommissioning; and
- identification of any significant effects, cumulative effects and suggested mitigation.

2.4.10 The study concluded that:

- the proposed SSA criteria were broadly in line with sustainability and environmental objectives;
- the discretionary nature of some criteria means that adverse environmental effects cannot be ruled out at the strategic level; and
- certain local level impacts are not addressed by the SSA but it is made clear that these would be addressed through EIAs accompanying individual planning applications.

The Update Report - January 2009

2.4.11 This report updated the environmental and sustainability impacts of siting new nuclear power stations on sites that would be identified through the application of the SSA criteria. Changes were made to three of the proposed SSA criteria as a result of the consultation. The proposed changes to the criteria were appraised

using the SEA objectives and found to be neutral or positive with regard to sustainability effects, as shown in the following table:

Table 2.4: Changes to SSA Criteria arising from consultation

SSA Criterion	Change arising from consultation	AoS Findings
Size of site to accommodate operation	Previously included size of site to accommodate construction and decommissioning which is now flagged for local consideration	Possibility that construction and decommissioning may require larger area than nominated is noted in AoS
Seismic risk (vibratory ground motion)	From exclusionary to flag for local consideration	Positive
Capable faulting	From exclusionary to flag for local consideration	Positive
Tsunami, storm surge and coastal processes	Tsunami and storm surge to be merged with flood risk. Coastal processes becomes a separate criterion.	Neutral

2.4.12 The studies concluded that the changes to the SSA criteria did not materially change the conclusion reached in the environmental study that the proposed SSA criteria are broadly in line with principles of sustainability and environmental protection. The update report also set out the Government's evolving thinking on the alternatives to be appraised following responses to the scoping report and comments made in responses to the consultation on the environmental study. The report also explained the changes from an SEA to an AoS, incorporating SEA, in accordance with the new requirements as set out in the Planning Act 2008.

Alternatives to the revised draft Nuclear NPS which were considered

2.4.13 Nuclear power stations have effects on sustainable development; the nature and scope of these effects essentially depend upon if nuclear power stations are built, how many are built, where they are built, and when they are built. The way in which the revised draft Nuclear NPS is developed, and its contents, will influence the number, location and timing of any nuclear power stations that might eventually be built by energy companies. The role of the AoS is to examine the sustainability effects of reasonable alternatives so that its findings can help inform the development of the draft NPS.

2.4.14 The AoS of EN-1 has considered alternatives of having an NPS which strike a balance between four criteria; cost, security of supply, reduction of greenhouse gas emissions and minimising environmental impacts other than greenhouse gas emissions. The alternatives considered in the AoS of EN-1 are ones which tilt the balance to favour one or more of these criteria to greater or lesser extent[54].

2.4.15 For this AoS, the Government has considered alternatives through a hierarchy as suggested by SEA and SA guidance as follows:

[54] DECC (2010) *Appraisal of Sustainability for the revised draft Overarching National Policy Statement for Energy* www.energynpsconsultation.decc.gov.uk

- Need: do we need the plan?
- Process: how should it be done?
- Location: where should it go?

2.4.16 The 25 SEA objectives agreed as a result of the scoping report in March 2008 were designed to appraise the SSA criteria and sites in detail. The factors covered by the SEA objectives were grouped into twelve Sustainable Development (SD) Themes for appraising the sites (see previously Table 2.2). These SD themes and topics covered by the SEA objectives were grouped into six broader headline topics for sustainability in order to make them more suitable for the higher level appraisals of the need and process alternatives as shown on Table 2.5.

Table 2.5: Headline Sustainable Development topics for the appraisal of Need and Process Alternatives

Headline Sustainable Development Topics	**AoS/SEA Topics** (numbers refer to objectives from the Scoping Report; *italics refer to topics suggested in the SEA Directive)*
Climate Change	Climate change (13) *Climatic Factors*
Security of Energy Supply	Communities, Health, Infrastructure (8, 9, 6, 7, 8, 9) *Population, Human Health, Material Assets*
Health and Safety	Communities, Health (6, 7, 11) *Population, Human Health*
Radioactive Waste Generation	Cross-cutting topic
The Natural Environment	Biodiversity and Ecosystems (1, 2, 3) Soil (19, 20, 21) Air (12) Water (14, 15, 16, 17, 18) Landscape (24, 25) *Biodiversity, fauna, flora, soil, air, landscape*
The Built Environment	Landscape (24, 25), Archaeology and Cultural Heritage (22, 23), Material Assets (8, 9) *Biodiversity, fauna, flora, landscape, cultural heritage including architectural and archaeological heritage, material assets*

2.4.17 Need – do we need the Nuclear NPS? Three possible high level scenarios were considered for the NPS:

- A Nuclear NPS in line with Government policy that includes guidance for the IPC on potentially suitable sites;
- A Nuclear NPS that prohibits the construction of new nuclear power stations; and
- No NPS - business as usual.

2.4.18 Process – how should the NPS be developed? The format and detail of the NPS can influence the number, location and timing of new nuclear power stations through the policy guidance and framework for decision making that it sets out for the IPC. Four potential options were identified:

- a Nuclear NPS with siting criteria only;

- a Nuclear NPS with a list of sites only;
- a Nuclear NPS with siting criteria and a list of sites; and
- a Nuclear NPS with siting criteria and a list of sites restricted to those in the vicinity of existing nuclear power stations.

2.4.19 Location – where should new nuclear power stations be built? Nominations for sites were invited by the Government during March 2009. Nominated sites were assessed against exclusionary and discretionary criteria and subject to AoS using the 25 SEA/AoS objectives (see Table 2.2).

Appraising the potentially suitable sites

2.4.20 The revised draft Nuclear NPS needs to incorporate both the national situation and also the local situations with regard to the potentially suitable sites in order to be able to guide the IPC to key issues that require particular attention when considering individual planning applications. The AoS appraised the Nuclear NPS as a whole at the strategic level and also each of the potentially suitable sites.

2.4.21 It is important that the sites AoSs are kept focused on strategic appraisal, highlighting key local issues, but avoiding duplication of the project level assessments, such as EIA, that will accompany subsequent individual planning applications to the new IPC. The AoS method was developed to acknowledge two levels of significance for sustainability effects associated with the sites:

- Local Effects: these include effects at the local level, e.g. an effect on a nearby County Wildlife Site, which are more appropriately addressed through the development consent process with the IPC. Each site was characterised and the key issues for sustainability summarised (including suggestions for mitigation of potential significant adverse effects) to inform the revised draft NPS in developing its guidance to the IPC; and
- Strategic Effects: these include effects that are more significant at the regional to national or international levels, for example, an effect on biodiversity of national and international value.

2.4.22 The AoS for each of the sites considered the relevant policy context at a regional level, which helped to identify key sustainability objectives that need to be taken into account in the appraisal and potential cumulative effects that could arise with other plans and projects. Existing and emerging local policy and information documents were considered, where relevant, for the characterisation of baseline conditions and the appraisal of effects. The site reports also took into account detailed information such as Environmental Statements accompanying current planning applications as they are in the public domain. Any gaps in information or uncertainties for the appraisals were recorded in the detailed working matrices. Summaries of strategically significant effects and mitigation possibilities were collated by topic and for each site individually, and included consideration of interactions, synergies, and cumulative effects. Details of these methods are set out in the Site AoS Reports[55] (Annexes A-H of this revised AoS Report).

[55] The reports are available at www.energynpsconsultation.decc.gov.uk

2.4.23 It was not intended to consider the implications of different nuclear power station designs at each nominated site. It is considered that these are better addressed at the project level by the developer, the regulators, and the planning consultation process. Therefore, the AoS made a number of assumptions about the generic design characteristics of new nuclear power stations.

2.4.24 The assumptions about generic design characteristics were summarised into a base case in order to provide a standardised approach to the appraisal of the sites. The base case was used to guide the appraisal for each site, except in cases where a nominator had provided further detail. For example, if a developer is proposing cooling towers instead of direct cooling, this has been considered in the appraisal. The key assumptions used for the site level AoSs are outlined in Table 2.6.

Table 2.6: Generic design characteristics for new nuclear power stations

Base case generic design characteristics for new nuclear power station
1 nuclear reactor
Technology neutral (i.e. unknown reactor type)
A requirement for cooling water abstraction
Discharges of cooling water
Site boundary as indicated on nomination form
Timescales: Construction: approximately 5-6 yrs Operation: approximately 60 years (subject to possible life extension that would require regulatory approval) Decommissioning: around 30 years Lifetime of site: approximately 166 years
No. of employees: Construction: approx 4,000 (around 50% from within region) Operation: approx 500 Decommissioning= range of 400-800 at key phases Associated employment creation= 2000
Coastal and flood protection measures (where relevant)
Infrastructure for transporting reactor (for example, jetty, landing facility)
Interim radioactive waste storage facilities will be capable for 160 years from first arising of waste[56]
Highway improvements, access routes
Associated transmission infrastructure
Other associated infrastructure/plant

[56] The site lifetime of 166 years assumes 6 years for construction, 60 years for operation and 100 years for interim storage of spent fuel after the last defueling. It is possible to envisage a scenario in which onsite interim storage might be required for around 160 years from the start of the power station's operation, to enable an adequate cooling period for fuel discharged following the end of the power station's operation. In making its assessment that onsite interim storage might be needed for 160 years, the Government took a conservative approach, to ensure that local communities are aware that it is possible that onsite interim storage might be required for this length of time. Following the public consultation, the Government has revised its position. The Government recognises that onsite interim storage might be required beyond 2130, particularly in the event that a GDF is not available to take the waste, but the Government does not expect onsite interim storage to be required for as long as 160 years. Further detail is set out in The Government Response to the consultation on the draft National Policy Statements for Energy, DECC, 2010, www.energynpsconsultation.decc.gov.uk

Base case generic design characteristics for new nuclear power station
Radioactive discharges will be within legal limits

2.5 The relationship between this Appraisal of Sustainability and the Appraisals of Sustainability of the other energy National Policy Statements

2.5.1 The revised draft Nuclear NPS is different from the other revised draft Energy NPSs because it includes a list of potentially suitable sites for new nuclear power stations. The AoSs for the other energy NPSs and this AoS relate to the scope of the NPSs and cover policy for energy Nationally Significant Infrastructure Projects (NSIPs) in England and Wales (and Scotland for certain cross border non-nuclear projects); the potentially suitable sites listed in the Nuclear NPS are located in England and Wales.

2.5.2 All the AoSs used an objectives-led assessment process in accordance with UK guidance on SEA and an integrated appraisal modelled on the Sustainability Appraisal method for spatial plans. This included an appraisal framework of Sustainable Development (SD) themes, AoS objectives and sub-objectives/guide questions.

2.5.3 The relationship between the two sets of appraisal frameworks for the non-nuclear energy AoSs and the Nuclear AoS is set out in Table 2.8 at the end of this chapter. There is direct correlation between most of the sustainability topics addressed. Some issues are categorised differently and this reflects their cross-cutting nature – they could be organised in a number of different categories of SD themes. These are explained as follows:

- Overarching AoS SD Theme Resources and Raw Materials: the Nuclear AoS considers energy infrastructure and (non-nuclear) waste management within Communities: Supporting Infrastructure with regard to capacity of services; potential indirect or secondary effects are considered in the relevant issue. Consideration of radioactive and hazardous waste is a unique characteristic of the Nuclear AoS and is addressed as a separate section in the AoS Report;

- Overarching AoS SD Theme Traffic and Transport: categorised within Communities: supporting infrastructure for the Nuclear AoS;

- Overarching AoS SD Theme Noise: people and fauna are the receptors with regard to noise. There are no specific guide questions relating to noise within the nuclear SA framework but the effects of noise are implicit in the guide questions for health and well-being, and biodiversity; consideration is also given to potential effects on cultural heritage and landscape through disturbance and loss of tranquillity;

- Overarching AoS SD Theme Equality: there is no specific reference to equality for the nuclear AoS but this is implicit in the objective for encouraging the development of sustainable communities.

2.5.4 Both the non-nuclear energy AoSs and the Nuclear AoS took a topic-based approach and for each SD Theme/objective for sustainability, the AoSs considered the policy context relevant to the appraisal, the current situation including any problems, the likely evolution without the revised draft NPS, and the likely effects of the revised draft NPS. The findings of the AoSs were provided to inform the development of the revised draft NPSs in an iterative and ongoing way.

2.5.5 Both the non-nuclear energy AoSs and the Nuclear AoS recognised categories (positive, negative, neutral) and two grades (major, minor) of effects and as set out for the Nuclear AoS above in Table 2.3). The Nuclear AoS had to accommodate both strategic and spatially specific appraisals - so for the site AoSs a distinction between locally (local, sub-regional) and strategically (regional, national, international) significant effects was also made (see below). The site AoSs also differentiated between the construction, operation and decommissioning phases of new nuclear power stations. All the AoSs considered significant inter-relationships, synergistic and cumulative effects between sustainability effects in accordance with the SEA Directive.

2.6 This Appraisal of Sustainability report, the public consultation and next steps

- Preparing the Appraisal of Sustainability Report
- Consulting on the revised draft NPS and the AoS Report
- Assessing any significant changes
- AoS Statement to accompany a designated NPS

2.6.1 This AoS report sets out the findings of the appraisals in Chapter 7. Recommendations arising from these findings were made to inform the development of the revised draft NPS; the key AoS recommendations and how the revised draft NPS responded is set out in Appendix 2[57].

2.6.2 Following the consideration of responses to the consultation held between November 2009 and February 2010 on the initial draft Nuclear NPS and AoS, some changes have been made in the drafting of the revised draft Nuclear NPS.

2.6.3 The key changes to the revised draft Nuclear NPS include[58]:

- the removal of repetition with EN-1 (the Need section in EN-6 is now in EN-1);
- clarification of what would happen if an application is received for a site not listed in the final Nuclear NPS;
- updated text on Regulatory Justification;
- clarification of the relationship between the planning regime and the regulatory framework;
- clarification with regard to proposals including facilities to manage radioactive waste;
- the removal of Kirksanton and Braystones from the list of potentially suitable sites with consequential changes to the assessment of cumulative impacts;
- detail of the sites assessments has been moved to Annex C of the revised draft Nuclear NPS; and
- details regarding the Government's consideration of waste management have been moved to Annex B of the revised draft Nuclear NPS**.**

2.6.4 For the purposes of this AoS, the key change to the revised draft Nuclear NPS is the removal of two sites (Braystones and Kirksanton) which are considered not potentially suitable for the deployment of new nuclear power stations by 2025. Dungeness also remains off the list. The revised draft Nuclear NPS contains eight

[57] www.energynpsconsultation.decc.gov.uk
[58] Further details of the key changes are set out in the Consultation Document which can be found at www.energynpsconsultation.decc.gov.uk

sites and this is a significant change from the initial draft Nuclear NPS with its list of 10 sites, particularly with regard to the change from four to two sites clustering in the north west of England. The revised AoS has re-appraised the assessment of cumulative effects.

2.6.5 Most of the responses to public consultation held between November 2009 and February 2010 on the AoS site reports related to details of the characterisations of the areas around the potentially suitable sites. Any relevant corrections and clarifications have been made in the revised AoS site reports and incorporated into this revised Main AoS Report. The key revision to the appraisal is consideration of the changes to cumulative effects in the north west of England.

2.6.6 The revised draft Nuclear NPS and this AoS report are available on the DECC website and details of how to comment are set out in the Consultation Document[59]. The Government has also published a draft monitoring strategy, covering all the energy NPSs, for public consultation. The Government will consider comments received during the public consultation and make any necessary updates to the revised draft Nuclear NPS which will be subject to ratification by Parliament before final designation. On designation of the final Nuclear NPS, an AoS Statement will be published which will outline how the findings of the AoS and the responses to consultation have been taken into account. It will also set out how monitoring will be taken forward.

2.6.7 The SEA Directive requires certain information to be provided in the "environmental report" and the relevant elements that refer to SEA within the AoS Report are set out in the table 2.7 below.

Table 2.7: Meeting the requirements of the SEA Directive

Key Requirement of the SEA Directive (information to be provided in the environmental report)	Location in this AoS Report
"*an outline of the contents, main objectives of the plan or Programme and relationship with other relevant plans and Programmes*" (Annex I(a))	Provided in Chapter 1
"*the environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan or Programme and the way those objectives and any environmental considerations have been taken into account during its preparation*" (Annex I(e))	Provided in Topic Appendices A1-A11 and Site Annexes A-H Summarised in Chapter 2 Summarised in Chapters 6, 7
"*the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or Programme*" (Annex 1(b))	Provided in Topic Appendices A1-A12 and Site Annexes A-H Summarised in Chapters 6, 7
"*the environmental characteristics of areas likely to be significantly affected*" (Annex I(c))	Provided in Topic Appendices A1-A11and Site Annexes A-H

[59] These documents are available at www.energynpsconsultation.decc.gov.uk

Key Requirement of the SEA Directive (information to be provided in the environmental report)	Location in this AoS Report
	Summarised in Chapters 6, 7
"*any existing environmental problems which are relevant to the plan or Programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/ EEC and 92/43/EEC*" (Annex I(d))	Provided in Topic Appendices A1-A11 and Site Annexes A-H Summarised in Chapters 6, 7 Chapter 3 also refers to Environment and Sustainability Study (July 2008)
"*the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. These effects should include secondary, cumulative, synergistic, short, medium and long-term permanent and temporary, positive and negative effects*" (Annex I(f))	Provided in Topic Appendices A1-A11 and Site Annexes A-H Summarised in Chapters 6, 7
"*the measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or Programme*" (Annex I(g))	Provided in Topic Appendices A1-A11 and Site Annexes A-H Summarised in Chapters 6, 7
"*a description of the measures envisaged concerning monitoring*…" (Annex I(i))	Provided in Chapter 8
"*an outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know how) encountered in compiling the required information*" (Annex I(h))	Provided in Chapters 3, 4, 5 Provided in Chapters 6, 7
"*a non-technical summary of the information provided under the above headings*" (Annex I(j))	Set out at the beginning of this report

2.7 Summary

2.7.1 Sustainability and environmental assessments are ongoing processes that progress from strategic to project levels. This AoS incorporates the requirements of the SEA Directive and has examined the significant effects of the revised draft Nuclear NPS on environmental and other relevant socio-economic factors at the strategic level. The process has followed Government guidance on SEA and Sustainability Appraisal. Methods of assessment, and the elements of the revised draft Nuclear NPS to be assessed, have been agreed through consultation and ongoing liaison with statutory consultees and other bodies.

Table 2.8: Relationship between the Appraisals of Sustainability of the energy NPSs - frameworks of themes and objectives for appraisal

AoS of other energy NPS **Themes and Objectives**	**AoS of Nuclear NPS** **Themes and Objectives** **Numbers refer to those used in SEA Scoping Report March 2008)**
SD Theme: Climate Change **AoS Objective:** **1. To minimise detrimental effects on the climate from greenhouse gases and ozone depleting substances and maximise resilience to climate change.**	**SD Theme: Climate Change** **AoS Objective:** 13. to minimise greenhouse gas emissions
Will the NPS ensure that the carbon throughput of the national portfolio of major energy infrastructure is reduced (at least in proportion to the carbon targets and budgets set under the Climate Change Act)? Will the NPS significantly change the direct or indirect emissions of carbon dioxide and other greenhouse gases? Will the NPS significantly change in the indirect emissions of carbon dioxide or other greenhouse gases due to changes in energy use? Will the NPS promote future proofing (e.g. through good design) against the effects and risks of climate change (e.g. sea level rise and changes in weather patterns)? Will the NPS promote long term adaptation to the effects of climate change? Will the NPS have wider implications for the mitigation of climate risks?	Will it take account of future effects and risks of climate change e.g. sea level rise? Will future changes in weather patterns be considered? Will it result in increased vehicular emissions (particularly carbon dioxide)? Will it result in increased emissions from asset construction, maintenance and demolition, waste recycling and disposal or other activities? Note: Adaptation to climate change is discussed in other relvant topic appriasals, eg. biodiversity, water, flood risk.
SD Theme: Ecology (Flora and Fauna) **AoS Objective:** 2. To protect and enhance protected habitats, species, valuable ecological networks and ecosystem functionality.	**SD Theme: Biodiversity & Ecosystem Services** **AoS Objective:** 1. to avoid adverse impacts on the integrity of wildlife sites of international and national importance 2. to avoid adverse impacts on valuable ecological networks and ecosystem functionality 3. to avoid adverse impacts on Priority Habitats and Species including European Protected Species
Will the NPS help to prevent damage to and enhance species and habitats (e.g. by promoting good design)? Will the NPS seek to minimise habitat fragmentation and severance of migration and commuter routes? Will the NPS promote new habitat creation or restoration and linkages with existing habitats? Will the NPS promote the sustainable	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

management of natural habitats? Will the NPS affect the structure and function of ecosystem processes? Will the NPS limit air pollution to levels which do not damage natural systems by acidification or eutrophication?	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 e.g. oil, fuel and other pollution into waterbodies 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?
SD Theme: Resources and Raw Materials **AoS Objective:** 3. To promote the sustainable use of resources and natural assets and to deliver secure, clean and affordable energy?	**SD Theme:** **AoS Objective:**
Will the NPS adhere to the waste management hierarchy? Will the NPS help to meet the joint challenge of tackling climate change and ensuring secure, clean and affordable energy? Will the NPS generate waste by products? Will the NPS promote the UK's competitiveness, vitality and adaptability within the energy market? Will the NPS promote security of supply in the energy market? Will the NPS have wider effects on energy economics?	Guide questions under Communities: Supporting Infrastructure: *Will it result in loss or disruption to basic services and infrastructure (e.g. electricity, gas)?* *Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?*
SD Theme: Economy and Skills **AoS Objective:** 4. To promote a strong and stable economy with opportunities for all.	**SD Theme: Communities: Population, Employment & Viability** **AoS Objective:** 4. to create employment opportunities 5. to encourage the development of sustainable communities 10. to avoid adverse impacts on property and land values and avoid planning blight
Will the NPS promote sustainable growth in the national economy? Will the NPS improve the reliability of the national energy supply? Will the NPS have wider socio-economic effects such as impact fuel poverty or have effects on specific groups?	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 a decrease in property and land values

Will the NPS promote investment for the long term? Will the NPS promote diversification of the economy? Will the NPS increase the national skills base? Will the NPS avoid adverse effects on the national economy?	as a result of a change in perceptions or blight?
SD Theme: Flood Risk **AoS Objective:** 5. To avoid, reduce and manage flood risk (including coastal flood risk) from all sources and coastal erosion risks by locating infrastructure in lower risk areas and ensuring it is resilient over its lifetime without increasing risks elsewhere.	**SD Theme: Flood Risk** **AoS Objective:** 14. to avoid increased flood risk (including coastal flood risk) and seek to reduce risks where possible
Will the NPS help to minimise the risk of flooding to existing properties and new energy infrastructure? Will the NPS help to discourage inappropriate development in areas at risk from flooding and coastal erosion? Will the NPS help to manage the risks associated with coastal erosion?	Will it result in demand for higher defence standards that will impact on coastal processes?
SD Theme: Water Quality **AoS Objective:** 6. To protect and enhance surface (including costal) and groundwater quality (including distribution and flow).	**SD Theme: Water Quality & Resources** **AoS Objective:** 15. to avoid adverse impacts on surface water hydrology and channel geomorphology (including coastal geomorphology) 16. to avoid adverse impacts on surface water quality (including coastal and marine water quality) and assist achievement of Water Framework Directive objectives 17. to avoid adverse impacts on the supply of water resources 18. to avoid adverse impacts on groundwater quality, distribution and flow and assist achievement of Water Framework Directive objectives
Will the NPS protect and improve ground and surface water quality in line with Water Framework Directive requirements? Will the NPS avoid adverse effects on costal water and fisheries? Will the NPS safeguard and enhance the UK's water resources and maintain water abstraction within carry capacity? Will the NPS help to implement the Water Framework Directive?	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? Can the higher defence standards be achieved without compromising habitat quality and sediment transport? Will it cause deterioration in surface water quality as a result of accidental pollution, for example spillages, leaks? Will it cause deterioration in coastal and / or marine water quality as a result of accidental pollution, for example spillages, leaks? Will it cause deterioration in surface water quality as a result of the disturbance of contaminated soil? Will it cause deterioration in coastal and / or marine water 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 water bodies? Will it increase the temperature of the water in water bodies? Will it adversely affect water supply as a result of abstraction? *Will it increase demand for water?* Will it cause deterioration in groundwater quality as a result of accidental pollution, for example spillages, leaks? Will it cause deterioration in groundwater quality as a result of the disturbance of contaminated soil?
SD Theme: Traffic and Transport **AoS Objective:** To minimise the detrimental impacts of travel and transport on communities and the environment, whilst maximising positive effects.	**SD Theme: Communities: Supporting Infrastructure** **AoS Objective:** 8. to avoid adverse impacts on the function and efficiency of the strategic transport infrastructure 9. to avoid disruption to basic services and infrastructure
7. Will the NPS significantly change national transport networks (e.g. a modal shift from road to rail)? Other localised issued have been scoped out of the appraisal. However, this will be reviewed as further information emerges.	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 *(e.g. electricity, gas)?* *Will it place significant pressure on local/regional waste management facilities (non-nuclear waste)?*
SD Theme: Noise **AoS Objective:** To protect both human and ecological receptors from disturbing levels of noise.	**SD Theme:** **AoS Objective:**
8. Will the NPS seek to minimise any adverse effects of noise?	Guide question under Health & Well-being: *Will exposure to noise and vibration as a result of plant activities lead to physical and mental health impacts on nearby communities?*
SD Theme: Landscape, Townscape and Visual **AoS Objective:** 9. To protect and enhance landscape quality, townscape quality and to enhance visual amenity.	**SD Theme: Landscape** **AoS Objective:** 24. to avoid adverse impacts on nationally important landscapes 25. to avoid adverse impacts on landscape character, quality and tranquillity, diversity and distinctiveness
Will the NPS seek to protect and enhance the character of landscapes and townscapes (e.g. by promoting good design)? Will the NPS seek to protect wilderness and areas of high landscape value? Will the NPS give consideration to strategic views designated in LDFs and views from designated areas (e.g. AONBs)?	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 National Scenic Area[60] 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

[60] This designation only applies in Scotland. It should be noted that none of the sites listed in the NPS are in Scotland.

	distinctiveness? Will it result in increased levels of light pollution?
SD Theme: Archaeology and Cultural Heritage **AoS Objective:** 10. Protect and where appropriate enhance the historic environment including heritage resources, historic buildings and archaeological features.	**SD Theme: Cultural Heritage** **AoS Objective:** 22. to avoid adverse impacts on the internationally and nationally important features of the historic environment. 23. to avoid adverse impacts on the setting and quality of built heritage, archaeology and historic landscapes
Will the NPS have any direct, indirect or cumulative effects on sites of universal cultural heritage importance (e.g. World Heritage Sites)? Will the NPS have any direct, indirect or cumulative effects on other national or local designated sites (e.g. Scheduled Ancient Monuments (SAMs), listed buildings, registered battlefield sites etc)? Will the NPS protect and enhance the historic environment? Will the NPS have any potential impact on historic landscape character with landscapes designated as nationally important such as National Parks and AONBs as well as conservation areas? The potential direct and indirect effects on sites at a local and regional level have been scoped out of the appraisal. This decision will be reviewed as further information emerges.	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?
SD Theme: Air Quality **AoS Objective:** 11. To protect and enhance air quality on local, regional, national and international scale.	**SD Theme: Air Quality** **AoS Objective:** 12. to avoid adverse impacts on air quality.
Will the NPS maintain and enhance air quality? Will existing areas of poor air quality be made worse?	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 AQMAs?
SD Theme: Soil and Geology **AoS Objective:** 12. To promote the use of brownfield land and where this is not possible to prioritise the protection of geologically important sites and agriculturally important land.	**SD Theme: Soils, Geology & Land Use** **AoS Objective:** 19. to avoid damage to geological resources 20. to avoid the use of greenfield land and encourage the re-use of brownfield sites 21. to avoid the contamination of soils and adverse impacts on soil functions
Will the NPS promote the wise use of land? Will the NPS safeguard soils and geology from potential contamination?	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?
SD Theme: Health and Well-Being **AoS Objective:** 13. To protect and enhance the physical and mental health of the population	**SD Theme: Human Health & Well-Being** **AoS Objective:** 6. to avoid adverse impacts on physical health 7. to avoid adverse impacts on mental health 11. to avoid the loss of access and recreational opportunities, their quality and user convenience
Will the NPS affect the physical health or well-being of the population? Will the NPS affect perceptions of risk? Will the NPS help to reduce health inequalities? Will the NPS affect recreational enjoyment of the countryside and coasts? There are a number of elements scoped out as they are location specific, e.g. will it encourage walking or cycling, will it affect an individual's access to health facilities and green spaces?	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 the perceptions of adverse risk as a result of activities lead to adverse impacts on mental health for nearby communities? Will it result in the loss of recreational and amenity land or loss of access? Will it adversely affect the ability of an individual to enjoy and pursue a healthy lifestyle?
SD Theme: Equality **AoS Objective:** 14. To encourage equality and sustainable communities.	**SD Theme:** **AoS Objective:**
Will the NPS result in changes to community services or facilities? Will the NPS affect the level of people in fuel poverty? Will the NPS reduce inequalities?	Implicit within AoS Objective 5 - to encourage the development of sustainable communities (under SD Theme Communities: Population, Employment & Viability)
	SD Theme: Radioactive and Hazardous Waste Has separate section in Nuclear AoS; cross-cutting effects are addressed in each topic that they are relevant to.

Findings of the AoS

Chapter 3. Alternatives Assessment for the Nuclear NPS: Need Alternatives

3.1 Introduction

3.1.1 Nuclear power stations have the potential to affect sustainable development. The nature and significance of these effects essentially depend upon if nuclear power stations are built, how many are built, where they are built and when they are built. The decision to prepare a Nuclear NPS, the way in which a Nuclear NPS is developed and its contents will have an impact upon the number, location and timing of any new nuclear power stations which might eventually be built by energy companies.

3.1.2 With regard to good policy and plan making, and in accordance with the requirements of the SEA Directive[61] a phased approach to assessing realistic options was taken for preparing the revised draft Nuclear NPS. It is not the purpose of the SEA or AoS to decide the alternative to be chosen for the plan - this is the role of the decision-makers preparing the plan. The AoS provides information on the relative performance of reasonable alternatives for the plan and helps make the decision-making more transparent. The phased approach[62] undertaken to assess alternatives was:

- **Need** – is the Nuclear NPS needed?
- **Process** – how should the Nuclear NPS be developed?
- **Location** – where should new nuclear power stations be built?

3.1.3 This chapter sets out the assessment of Need. Chapter 4 sets out the assessment of Process and Chapter 5 sets out the assessment of Location.

3.1.4 The Government considered that there were three possible high level and realistic options for assessing whether a Nuclear NPS is needed:

- **Nuclear NPS** - an NPS in line with Government policy;

[61] The SEA Directive requires that "…*the likely significant effects on the environment of implementing the plan or programme, and reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme are identified, described and evaluated*." (Article 5.1). The Practical Guide to SEA advises that "*only reasonable, realistic and relevant alternatives need be put forward*" and that they should be "*sufficiently distinct to enable meaningful comparisons*" of their different effects on the environment.

[62] This structure was first set out in DECC (Jan 2009) *Applying the Strategic Siting Assessment Criteria; an update to the study of the potential environmental and sustainability effects*

- **NPS that prohibits Nuclear** - an NPS that prohibits the construction of any new nuclear power stations which would result in other infrastructure being built because new nuclear is not part of the energy mix; and

- **No NPS** - a business as usual scenario where there is no Nuclear NPS to set the framework for development consents but where new nuclear could still come forward.

How the assessment is structured

3.1.5 The AoS appraised the three options using headline sustainable development (SD) topics appropriate for a high level strategic assessment. These broad SD topics were collated from the AoS objectives for sustainability and the approach is described in more detail in Chapter 2 including Tables 2.2 to 2.6.

3.1.6 For each SD topic, a comparison is made between the three high level options as follows:

- any generic impacts of energy infrastructure under the relevant topic which would arise under all three options (e.g. generic impacts of energy infrastructure built under the **Nuclear NPS**, **NPS that prohibits nuclear** and **No NPS** options);

- any different impacts of building new nuclear power stations under the relevant topic if there is a **Nuclear NPS**;

- any different impacts of building CCGT power stations and renewables under the relevant topic if there is an **NPS that prohibits Nuclear**; and

- any different impacts of building new nuclear power stations, CCGT power stations and renewables under the relevant topic if there is **No NPS**.

How we have reached assumptions in the assessment

3.1.7 The assessment did not predict what might happen if the energy policy was redrawn or if a particular energy mix was prescribed other than to the extent set out in the three options.

3.1.8 It is not possible to predict with 100% certainty what the energy mix would look like if nuclear were not part of the energy mix (under the **NPS that prohibits nuclear** option). To reach reasonable assumptions, modelling and data sources are used. This assessment refers to:

- Updated Energy and Emissions Projections 2010[63];

- modelling which was carried out by Redpoint[64] to see what might happen if nuclear were excluded from the energy mix; and

[63] DECC (2010) *Updated Energy and Emissions Projections* http://www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx

[64] Redpoint et al for DECC (2009) *Implementation of the EU 2020 Renewable Target in the UK Electricity Sector: RO Reform, no new nuclear build sensitivities* www.energynpsconsultation.decc.gov.uk

- MARKAL modelling which was carried out to inform the Committee on Climate Change report "Building a low carbon economy – the UK's contribution to tackling climate change"[65].

3.1.9 In conducting the assessment, we have also drawn on the evidence and analysis set out in the Nuclear White Paper[66] where appropriate. We have also relied on more recent evidence and analysis to ensure our assessment is up-to-date.

3.2 What are the alternatives likely to mean in practice?

3.2.1 **A Nuclear NPS** in line with Government policy - will set a framework for the Infrastructure Planning Commission (IPC) when consenting new nuclear power stations. Nuclear power stations will be built by energy companies assuming that private investment is forthcoming. The IPC would consider applications for new nuclear power stations using the NPS which sets out the national need and a list of potentially suitable sites which have been assessed against Strategic Siting Assessment criteria, Appraisals of Sustainability and Habitats Regulations Assessments. The IPC would then make a recommendation to the Secretary of State. This will result in development consents being considered more quickly than if there were **No NPS**. It should be noted that in the event that a development consent application for a new nuclear power station is submitted to the IPC for a site not listed in the Nuclear NPS, the IPC would also make a recommendation to the Secretary of State[67].

3.2.2 **An NPS that prohibits nuclear** would mean that development consent would not be granted for any new nuclear power stations. The existing nuclear power stations would not be replaced when they come to the end of their operating lifetime. This would mean that any requirement for new generating capacity would have to be met by another type or types of generating infrastructure.

3.2.3 Redpoint analysis[68] suggests that in a scenario of central fossil fuel and high fossil fuel prices, if nuclear power was excluded from the energy mix it would be replaced with new gas fired generation. This is supported by MARKAL modelling for the Committee on Climate Change (CCC) looking at the generation mix in 2030. The MARKAL modelling suggested that in the absence of new nuclear power, and where Carbon Capture and Storage (CCS) is not available at reasonable cost[69], then new generation capacity is likely to be predominantly gas fired power station with some

[65] The Committee on Climate Change (2008) *Building a low-carbon economy – the UK's contribution to tackling climate change.* For a detailed explanation of MARKAL modelling see page 77, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

[66] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, http://www.berr.gov.uk/files/file43006.pdf

[67] The NPS would not have effect and the Secretary of State would consider whether there was a need to review the SSA criteria and/or conduct a further SSA.

[68] Redpoint et al for DECC (2009) *Implementation of the EU 2020 Renewable Target in the UK Electricity Sector: RO Reform, no new nuclear build sensitivities*

[69] The complete chain of CCS has yet to be demonstrated at commercial scale on a power station. Whilst there is a high level of confidence that the technology involved in CCS will be effective, less is known about the impact of CCS on the economics of power station operation. There is therefore uncertainty about the future deployment of CCS in the economy and how this will be achieved. The Government is supporting the cost of four commercial commercial-scale CCS demonstration projects. The Government is requiring that all commercial scale (at or over 300MW) combustion power stations have to be constructed carbon capture ready and new coal fired power stations are able to demonstrate CCS on a commercial scale. The expectation is that any new coal fired power stations constructed after 2020 will install CCS for the entire power station at the outset, and that previously consented power stations will fully retrofit by 2025.

renewables. In the assessment gas fired generation is referred to as CCGT (combined cycle gas turbine).

3.2.4 **No NPS** is the "*business as usual*" scenario which would mean that energy companies could still apply for development consent for new nuclear power stations. However, the Government would not produce a Nuclear NPS. The IPC would consider an application for development consent and make a recommendation to the Secretary of State. The IPC would need to consider the application in the absence of a statement of national need for nuclear power, a list of potentially suitable sites and specific planning guidance provided by the NPS. This would mean that nuclear power stations could still be consented and built but some of the benefits of the new planning regime would not be realised. It is difficult to assess what the likely number, timing and location of nuclear power stations in such a scenario might be although it is highly likely that development consent would take longer.

3.2.5 Under the Planning Act 2008, where there is no NPS in place and the IPC is acting as a recommending body with the Secretary of State taking decisions, the IPC is supposed to complete its report to the Secretary of State within nine months of holding its preliminary meeting with the applicant and interested parties in respect of the application. Following receipt of the report, the Secretary of State has a further three months to make a decision as to whether or not to grant consent. This means that development consent could be granted in 12 months of the application being received by the IPC. However, the IPC has the power to extend the time it is given to examine the application. It is more likely to need to extend its timetable without an NPS to set the framework for development consent because it may have to consider the questions of need, the suitability of a location and whether there are alternative locations, and it will not have designated planning policy on particular issues. The Secretary of State also has the power to extend the three month period given to decide an application. This could result in delays to the planning process which would increase uncertainty for energy companies and if the other Energy NPS were designated, make nuclear power a less attractive option. If there were a designated fossil fuel NPS and renewables NPS, CCGT power stations and renewables could be given development consent faster than nuclear power stations.

3.2.6 As highlighted above, it is unclear what the impact of **No NPS** would be on the exact number and timings of new nuclear capacity. In the absence of an NPS it could be likely that fewer new nuclear power stations would be built than with a Nuclear NPS because development consents would take longer and developers would have less certainty about how particular issues would be dealt with by the IPC. It may also lead to firms choosing to invest in other generation technologies than nuclear power.

3.3 The wider context of UK energy policy

3.3.1 The Government examined the Need options against the broader context of current UK energy policy.

3.3.2 The UK needs to ensure energy security, availability and affordability. At the same time the UK needs to move to low carbon sources as soon as possible and to largely decarbonise the power sector to meet its objectives. The UK has a legally binding target to cut greenhouse gas emissions by 80% by 2050 relative to 1990 levels. The Committee on Climate Change has stated that his reduction can only be

achieved if electricity generation is almost largely decarbonised by 2050. Electricity generation currently accounts for around 37% of the UK's total CO_2 emissions and around three quarters of the UK's electricity is currently generated using coal and gas[70], which produces CO_2 emissions and contribute to global warming.

3.3.3 Several factors make clear there will be a need for a significant amount of new electricity generation infrastructure for both renewable and conventional generation in the energy supply mix by 2025.

3.3.4 A significant amount of existing generating capacity (around 22GW) is due to close by around 2025 either because it does not meet European emissions standards or because power stations are coming to the end of their natural operating lives. To meet the Government's objective to maintain levels of energy security, and because electricity is an essential component of any modern society, there is a need to replace capacity as well as to meet expected increases in demand for electricity generation. The option of not doing so is not tenable because of the harmful impacts on human health, public safety and economic growth.

3.3.5 Beyond 2025 the increased use of electricity as a way of decarbonising the economy is likely to increase the demand for electricity. The Government's 2050 Pathways Analysis considers different scenarios by which the UK can move to a secure low carbon economy by 2050[71]. Whilst there are different pathways by which the UK can meet its 2050 objectives, common themes from the different pathways have emerged which show:

- ambitious per capita demand reduction is needed and the greater the constraints on low carbon energy supply the greater the reduction in demand will need to be;
- a substantial level of electrification of heating, transport and industry will be required;
- electricity demand could double by 2050 from current levels; and
- the electricity supply will need to be decarbonised.

3.3.6 The 2050 Pathways Analysis shows that reductions in electricity consumption resulting from improvements from electricity efficiency will be far outweighed by increases in electricity demand potentially leading to a doubling of electricity demand between now and 2050. If electricity demand were to double, generation capacity would also need to double if it was supplied by nuclear and fossil fuels with CCS. If one third of the electricity were to be supplied by renewables, generation capacity would need to triple because more capacity would be needed to account for the intermittency of renewables.

[70] The Committee on Climate Change (Dec 2008) *Building a low carbon economy – the UK's contribution to tackling climate change*, p173 & p175 http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

[71] The 2050 Pathways Analysis was published as part of a call for evidence in July 2010. http://econsultation.decc.gov.uk/decc-executive/2050_pathways/consult_view

3.3.7 The Updated Energy and Emissions Projections (UEP) show that, assuming demand for electricity in 2025 is at similar levels to today, in one scenario around 59GW of new capacity will be required by the end of 2025[72].

3.3.8 The UEP scenarios all assume that electricity demand in 2025 will be approximately at the same level as today. Whilst increased energy efficiency measures and the impact of the recent recession mean that some industry models support this assumption[73], it is quite possible that any of these scenarios may underestimate the increased use of electricity by 2025 as the UK moves to decarbonise. This means that the amount of new capacity shown in the scenarios (including the high scenario) may be too low.

3.3.9 The UK has a dynamic energy market influenced by Government policy measures and strategic interventions. The Government does not procure, build or run electricity generating stations. If nuclear power stations were not part of the energy mix it would be for private companies to bring forward proposals to build electricity generating infrastructure to fill requirement for generation. Generally speaking, private companies would choose to invest in the types of electricity generating infrastructure which offer the most attractive returns to them[74].

3.3.10 Whether or not to build new nuclear power stations is a commercial decision that will be taken by energy companies. A number of factors influence the economic viability of nuclear power stations; these include the relative capital costs of new nuclear power stations compared to other generation technologies, fossil fuel prices and carbon prices[75].

3.3.11 It is not certain exactly how much new nuclear capacity might be built by 2025. High build rates have been achieved in France where 54 units came into operation between 1977 and 1993, an average of 3.2 units per year[76]. Energy companies have already announced their intentions to potentially develop up to 16GW of new nuclear power generation in England and Wales[77] [78] [79].

[72] DECC (2010) *Updated Energy and Emissions Projections*. The scenario used is the high fossil fuel and high carbon prices scenario. It should be noted there is a significant amount of uncertainty in forecasting future demand and capacity. EN-1 sets out that the Government considers it appropriate to consider the high scenario because it is prudent to plan for the greatest potential need for new electricity generating infrastructure.
[73] National Grid projections (published in April 2010) suggest in some scenarios electricity demand may remain at today's levels by 2025.
[74] Energy companies will also take other factors into consideration such as the ability to secure fuel supplies at a competitive price and other risks associated with the technology. To manage risks many energy companies invest in a variety of generating capacity.
[75] Mott McDonald for DECC (2010) *UK Electricity Generation Update* , p73. This study on the costs of generation concluded that in the longer term as nuclear moves to "nth of a kind" status and as carbon and fuel prices rise, nuclear is projected to become the least cost low carbon generation option. It should be noted there is a premium on "first of a kind".
[76] Nuclear Energy Association (2008) *Nuclear Energy Outlook 2008, NEA no. 6348*, p318
[77] http://www.rwe.com/web/cms/en/216362/rwe-npower/more-/our-business/nuclear-power/ http://pressreleases.eon-uk.com/blogs/eonukpressreleases/archive/2009/04/29/1382.aspx
[78] http://www.centrica.co.uk/index.asp?pageid=217&newsid=1783
[79] http://www.edfenergy.com/media-centre/press-news/EDF_Energy_welcomes_Government_announcement_on_nuclear_sites.shtml

3.4 Climate change

Generic impacts

3.4.1 Electricity generating infrastructure can have both positive and negative effects on climate change.

3.4.2 During the construction of any type of energy infrastructure, carbon emissions will be produced through the manufacture of steel, concrete and other materials, and the transportation of these materials.

3.4.3 During operation, fossil fuel power stations (oil, gas and coal) emit CO_2 into the atmosphere. By contrast, at the point of generating electricity, nuclear power stations and renewable generating infrastructure do not emit CO_2.

3.4.4 The UK has a legally binding target to cut emissions by 80% relative to 1990 levels by 2050. This is enshrined in the Climate Change Act 2008. The Committee on Climate Change has stated that this reduction can only be achieved if electricity generation is almost completely decarbonised by 2030[80]. If the targets to cut emissions were to become even stricter, for example, as part of new international agreements, the decarbonisation of the electricity sector and the pace of change would become even more pressing.

3.4.5 Global[81] and UK[82] impacts of climate change are well documented[83]. The UK Climate Change predictions show that, for the UK, if emissions are not reduced it could mean increased risk of droughts, flooding, heat waves and species struggling to adapt[84].

Nuclear NPS

3.4.6 Nuclear power is a low-carbon energy source[85]. During construction of new nuclear power stations there would be short term CO_2 emissions. The 2008 White Paper on Nuclear Power[86] reviewed the evidence on the lifecycle CO_2 emissions from nuclear power stations (including the construction of power station and the mining and transportation of uranium) concluding that a range of 7-22g/kWh represented a prudent range. This estimate is in line with research published by the OECD and IAEA. Using this range, the annual reduction in CO_2 of replacing 1 GW of gas fired plant with 1 GW of nuclear power is between 2.41 and 2.54 million tonnes.

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[80] The Committee on Climate Change (Dec 2008) *Building a low-carbon economy – the UK's contribution to tackling climate change*, p197, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

[81] Intergovernmental Panel on Climate Change (2007) *Fourth Assessment Report,* http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm#1

[82] Natural England (2008) *The Natural Environment: Adapting to Climate Change*, http://www.naturalengland.org.uk/Images/NE118-MainSummary_tcm6-10445.pdf

[83] HM Treasury (2006) *Stern Review: The Economics of Climate Change* http://www.hm-treasury.gov.uk/stern_review_report.htm

[84] DECC, July 2009 *The UK Low Carbon Transition Plan, National Strategy for climate and energy*, http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx

[85] Sustainable Development Commission (2006) *The Role of Nuclear Power in a Low Carbon Economy, Paper 2: Reducing CO2 emissions – Nuclear and the Alternatives*, http://www.sd-commission.org.uk/publications/downloads/SDC-NuclearPosition-2006.pdf

[86] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, http://www.berr.gov.uk/files/file43006.pdf

3.4.7 There is a risk that if investment in line with the Renewable Energy Strategy is not forthcoming, it will not be possible to substitute nuclear power (low-carbon generation) for renewables at short notice, given the long project lead times. The solution would be further investment in CCGT power stations, with concomitant increases in emissions. The generation mix is therefore a crucial driver of year by year emissions.

NPS that prohibits Nuclear

3.4.8 This option would result in more CO_2 being emitted as CCGT power stations are built instead of nuclear power stations. As an illustration if existing nuclear power stations were all replaced with fossil fuel power stations, emissions would be between 8 and 16Mtc[87] (million tonnes of carbon) higher as a result, depending upon the mix of gas and coal fired power stations.

3.4.9 To meet the UK's 2050 emissions reduction targets without nuclear power would require a large increase in other forms of electricity generation including wind power and fossil fuels with CCS. However, the alternative of CCS for power generation is not yet proven on a commercial scale and it is not certain it will be deployed on a sufficient scale before 2025. The revised Overarching NPS explains that fossil fuel with CCS is needed to complement nuclear and renewables rather than being an alternative to them.

No NPS

3.4.10 The No NPS option would mean that there could be greater uncertainty in planning. This could result in delays in nuclear power stations being consented and make nuclear power a less attractive option for energy companies. Any CCGT power stations which are built instead of nuclear power stations would emit CO_2 during operation which would have a negative effect on climate change, although any renewables which came forward under this option would not. It is not possible to predict exactly how much capacity would be filled by CCGT or renewables under this scenario.

Summary Findings of the AoS

3.4.11 Of the three options, the Nuclear NPS option appears best able to contribute to the UK's goal of increasing the amount of electricity from low carbon sources. The No NPS option would create uncertainty and could delay deployment of new nuclear capacity. The indications from the Redpoint modelling are that if new nuclear is not deployed, additional CCGT power stations will be built instead. The economic modelling also suggests that with the NPS that prohibits nuclear option, new CCGT power stations would be built leading to increased CO_2 emissions compared to the Nuclear NPS option. The lifetime CO_2 emissions from nuclear power are about the same as wind based generation technology, on reasonable assumptions, and are significantly lower than gas powered generation[88].

[87] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, p48. The range of 8 to16MtC is for the impact on emissions of existing power stations. This was based upon the stations being replaced by either new gas (8MtC) or new coal (16MtC). If the nuclear power stations were replaced by existing coal stations, the figure would be higher at 20MtC.
[88] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, p48-53, http://www.berr.gov.uk/files/file43006.pdf

Government's preferred alternative

3.4.12 Having considered the findings of the AoS and other information, the Government's preferred alternative is to take forward the revised draft Nuclear NPS because new nuclear power stations can make a contribution to cutting CO_2 emissions alongside renewable and carbon capture and storage. It is imperative that action is taken now to tackle climate change otherwise the most dangerous impacts will not be avoided and there will be adverse environmental, economic and social consequences globally and for the UK.

3.5 Security of energy supply

3.5.1 Security of Energy Supply (also known as Energy Security or Security of Supply) is about making sure the UK has reliable, affordable, secure supplies of energy. In recognising that secure supplies can never be guaranteed, the approach is to identify and manage the risks to security of supply. Several factors influence security of energy supply:

- firstly, there must be sufficient capacity in the energy system, so that there is a safety margin between likely demand and the physical ability to meet that demand. This ensures that supply is protected against unexpected events such as extreme weather and power station outages;
- secondly, the capacity on the system, and the accompanying infrastructure, must be reliable enough to deliver energy when required;
- thirdly, the range of energy sources should be diverse. Diversity can be technological (a wide range of generating technologies and fuels) and geographic (fuels imported from a wide range of countries, avoiding undue reliance on specific nations). A range of technologies and fuels reduces the impact that problems with one technology or fuel can have on supply in general, thereby reducing the risk of costly interruptions. A diverse source of fuels also ensures that the UK is not dependent on particular countries for its fuel imports; and
- finally, there should be effective price signals that reflect the true costs to companies of generating energy and the value consumers attach to buying it. This enables the market to balance electricity supply and demand in the short term, and ensure timely investment in new capacity over the longer term.

3.5.2 While each of these factors is necessary to manage the risks of supply interruptions, they are not on their own sufficient to ensure secure supplies of electricity are available. For example, the intermittent nature of wind generation means sufficient supplies of electricity cannot be guaranteed at any point in time, regardless of the amount of installed wind generation capacity.

3.5.3 The security of the electricity system as a whole needs to be consistently maintained over time in order to accommodate fluctuations in the conditions that affect supply and demand of electricity throughout the electricity supply chain. This means that sufficient timely investment is required to accommodate growth in demand, replace retiring power stations and to maintain the reliability of infrastructure throughout the supply chain.

Nuclear NPS

3.5.4 Having a Nuclear NPS will facilitate the construction and subsequent deployment of nuclear power stations in the energy mix. Having nuclear power in the UK electricity mix will help to ensure that it remains diverse, both in terms of technology and fuel source. Having a diverse mix of fuels and technologies to generate electricity increases the resilience of the system as it reduces exposure to the risks of supply interruptions and of sudden and large spikes in the electricity price, which can arise when the system is particularly dependent on a single technology or fuel.

3.5.5 Diversity of supply in electricity is maximized where the mix of technologies that energy companies can invest in have different characteristics. The characteristics of nuclear power are very different from those of conventional fossil fuel or renewables generation[89]. The presence of nuclear power in the mix therefore allows extra scope in managing risks to energy security. The characteristics of nuclear power that can affect energy security are set out below.

3.5.6 The UK is increasingly reliant on imports for electricity generation fuels. Long-term global fossil fuel reserves are declining, and there are concerns as to whether producer countries will make sufficient investments to exploit remaining reserves fully.

3.5.7 Nuclear fuel supply is a stable and mature industry. The International Atomic Energy Agency (IAEA) has concluded that sufficient nuclear fuel resources exist to meet current energy demands and to meet increased demand well into the future. Uranium is currently mined in 20 different countries[90]. Nuclear power can therefore help spread the supply risks that could be associated with a particular fuel or region of the world, thus making the electricity system less vulnerable to supply interruptions.

3.5.8 The presence of nuclear power in the electricity mix could result in a reduced need for gas-fired power stations, and thereby reduce gas import requirements, which could be beneficial given that some gas supplies are concentrated in countries at greater risk of political instability. Moreover, the supply chains of nuclear fuel, gas and coal are not interdependent and an interruption in the supply of gas or coal is unlikely to affect the supply of uranium. Consequently, the option of including new nuclear power in a diverse mix increases the diversity of input fuels that we are reliant on and spreads the risks of fuel supply interruptions[91].

3.5.9 The input fuel costs of nuclear power are lower as a proportion of total cost than coal and gas-fired generation[92], and are also more stable[93]. Fuel costs make up approximately 5 to 8% of total costs for nuclear power while fuel costs are the largest component of total costs for gas fired generation, estimated to be around 50

[89] DTI (May 2007) *The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document* , p55, http://www.berr.gov.uk/files/file39197.pdf
[90] OECD Nuclear Energy Agency and the International Atomic Energy Agency (2010) *Uranium 2009: Resources, Production and Demand*. http://www.oecdbookshop.org/oecd/display.asp?CID=&LANG=EN&SF1=DI&ST1=5KMD4HVHN4ZR
[91] DTI (May 2007) *The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*,, p56, http://www.berr.gov.uk/files/file39197.pdf
[92] DTI Analysis, 2006
[93] International Monetary Fund (March 2007) *Summary Volatility Statistics*

to 60%[94]. Historically, gas-fired power stations have been seen as the marginal generation plant which sets the wholesale price of electricity. However, the cost profile of nuclear power with low operating costs and low long-run marginal costs means that nuclear power can effectively place downward pressure on long-run wholesale prices[95].

3.5.10 If future gas prices continue to be high and available fossil fuel resources become increasingly constrained, the costs of conventional fossil fuel based generation could increase, putting upward pressure on electricity prices. Similarly, higher carbon prices would undermine the economics of fossil fuel fired power stations, raising their generating costs. Nuclear power can therefore be beneficial in reducing exposure to these risks of higher generation costs.

3.5.11 It is important to also recognise the limitations of nuclear power in ensuring security of supply. As a large amount of intermittent wind power comes on to the system over the coming years, it will therefore still be important to maintain fossil fuel power stations in the electricity mix in order to provide back-up generation.

3.5.12 Technical faults in a nuclear power station could result in a station being offline (as has occurred with some of the existing UK fleet). However, any new nuclear power stations that are built in the UK are likely to be evolutions of significantly more reliable designs.

NPS that prohibits Nuclear

3.5.13 The option of NPS that prohibits Nuclear would mean that nuclear power stations are not part of the UK's future energy mix, leaving the UK with a less diverse range of technologies and fuels to generate electricity. This lack of diversity would leave the UK more exposed to the risks of supply interruptions and of sudden and large spikes in the electricity price, which can arise when the system is particularly dependent on a single technology or fuel.

No NPS

3.5.14 If there is No NPS, some nuclear power stations might still come forward and make a contribution to the energy mix, but there would be greater uncertainty and it could make nuclear power a less attractive option. This means that fewer nuclear power stations could be built in comparison to the Nuclear NPS option and it would not play the same role in ensuring energy security.

Summary Findings of the AoS

3.5.15 On balance, the Nuclear NPS option is the one which will give the most certainty that nuclear power stations would be developed. This option, therefore, would make a bigger contribution to security of supply than the options of an NPS that prohibits Nuclear and No NPS. If the NPS that prohibits Nuclear option is chosen, then

[94] Mott McDonald for DECC (2010) *UK Electricity Generation Costs Update*. Costs are for "nth of a kind" and includes the cost of carbon. See Case 5 on page 87 of www.decc.gov.uk/assets/decc/statistics/projections/71-uk-electricity-generation-costs-update-.pdf

[95] DTI (May 2007) *The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*, p57, http://www.berr.gov.uk/files/file39197.pdf

nuclear power could not make this contribution. If the No NPS option were chosen, there is a risk that there might be fewer new nuclear power stations.

Government's preferred alternative

3.5.16 Having considered the findings of the AoS and other information, the Government's preferred alternative is to take forward the draft Nuclear NPS. The Government believes that the Nuclear NPS will help the UK to maintain a diverse mix of electricity generating technologies with the flexibility to respond to future developments. Nuclear power can make an important contribution to managing energy security risks, and therefore to ensuring reliable, affordable, secure supplies of electricity. Therefore the Government believes that it should proceed with the Nuclear NPS.

3.6 The economy

3.6.1 Assessing the effects of low-carbon (**Nuclear NPS**) electricity generation against gas-fired electricity generation (**NPS that prohibits nuclear**) on the economy is complex. The Committee on Climate Change attributes this complexity to four main factors:

- fossil fuel price volatility and uncertainty – when fossil fuel prices are low, all low-carbon alternatives face a cost penalty. With high fossil fuel prices, technologies such as nuclear and renewables are cost effective without any policy intervention. Further, price volatility and uncertainty is expected to continue into the future; different stages of technological development – relative cost figures often depend on comparisons of actual costs of one (mature) technology (for example, nuclear) against estimated future costs of another (for example, CCS);

- long-term cost trends – estimated future costs of renewables and new nuclear generation power stations, and of CCS depend on assumptions about future cost reduction potential – minor changes in assumptions can dramatically shift the relative cost of different technologies; and

- short-term cost trends and supply bottlenecks – supply bottlenecks drive up prices (e.g. increases in wind turbines and solar photovoltaic panels, increased costs of new nuclear and fossil fuel build) although these may ease or disappear with time. Estimates of relative technology costs are therefore sensitive to when the costs were calculated and assumptions about future supply bottlenecks. This can result in overstating costs of already deployed technologies against newer technologies.

Nuclear NPS

3.6.2 New nuclear viability is primarily driven by the relative capital costs of different technologies and fossil fuel and carbon prices. Based on current estimates of future fuel and carbon prices the levelised[96] cost of most forms of renewable electricity

[96] Levelised cost is a measure used to calculate the cost of electricity generating technologies. The capital cost is added to operating costs (and back end costs in the case of nuclear) and divided by the amount of electricity the power station is expected to generate during its lifetime. It is usually expressed as cost per kWh or MWh.

generation is higher than that of nuclear or conventional fossil fuel generation[97]. However, while the levelised cost of renewables is higher than other forms of generation, they are expected to fall as technologies are deployed more widely[98].

3.6.3 The Committee on Climate Change argues that although the future path of fossil fuel prices is inherently uncertain, under high fossil fuel price scenarios, nuclear power is fully economic compared to coal and gas generation even before the impact of a high carbon price, and even more so given the possible range of future carbon prices. Nuclear power will reduce future reliance on imported gas.

3.6.4 Two main economic arguments are usually made against new nuclear build; high decommissioning and waste disposal costs, and limited uranium supplies. Evidence from the Committee on Climate Change suggests that the £80 billion decommissioning and waste disposal costs from the previous nuclear programme are often cited in the economic case against nuclear. The Committee on Climate Change argues, however, that the vast majority of this cost was incurred during military research in the 1940s to 1960s, and through the operation of Magnox reactors; these are not relevant to future costs[99]. The £3.4 billion decommissioning costs estimated for the ten advanced gas-cooled reactors are more relevant, and costs for latest generation stations may be lower still.

3.6.5 New nuclear power build[100] is likely to result in increased employment during construction and operation of new power station. It should be noted, however, that employment opportunities would also exist in alternative sources of energy supply. It is therefore hard to determine the scale of net increase in employment that would result from investment in new nuclear capacity over and above other forms of generation capacity.

3.6.6 The construction and operation of different types of power stations can have different local employment impacts. As an illustration, a 1.6GW nuclear plant could employ up to 4000 people during construction and 500 during operation. A 1.3GW CCGT power station could employ around 1000 people during construction and 40 during operation.

NPS that prohibits Nuclear

3.6.7 Redpoint[101] have carried out analysis on the impact of excluding new nuclear from the electricity generation mix up to 2030. Under a scenario of central fossil fuel and carbon prices it is estimated that excluding new nuclear results in a net welfare loss to the economy. The is primarily due to relatively low cost nuclear generation being replaced with higher cost alternatives as well as the reduced value of the carbon dioxide emissions savings that would be available from nuclear power stations.

3.6.8 Modelling for the CCC report using MARKAL, finds that if CCS were unavailable at reasonable cost out to 2050, then a significant expansion of nuclear power (to

[97] Mott McDonald for DECC (2010) *UK Electricity Generation Costs Update* www.decc.gov.uk/assets/decc/statistics/projections/71-uk-electricity-generation-costs-update-.pdf
[98] The Committee on Climate Change (2008) *Building a low-carbon economy*, p192, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf
[99] The Committee on Climate Change (2008) *Building a low-carbon economy*, p188, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf
[100] Costs of nuclear deployment can be reduced if multiple new nuclear stations were built rather than one or two.
[101] Redpoint et al for DECC (2009) *Implementation of the EU 2020 Renewables Target in the UK Electricity Sector: RO Reform. No new nuclear sensitivities.*

nearly 40 GW by 2050)[102] and some further expansion of renewables would be the least-cost option to meet emissions reductions of 80%, with an additional loss in economic surplus of £17.5bn (real 2000 prices, discounted out to 2050). If nuclear as well as CCS were not available, the modelling suggest that 80% (or even 90%) emissions reductions would still be attainable, but only at substantial additional cost, with the loss in economic surplus increasing a further £79.2bn[103].

3.6.9 The construction, operation and decommissioning of CCGT power stations and renewables generating infrastructure would result in employment. It should be noted, however, that employment opportunities would also exist in alternative sources of energy supply. It is therefore hard to determine any net increase in employment that would result from investment in CCGT and renewables over and above other forms of generation capacity.

No NPS

3.6.10 The impact of No NPS is expected to be similar to the Nuclear NPS, although there is no certainty about the number of new nuclear power stations which might be built.

Summary Findings of the AoS

3.6.11 It is difficult to determine if one option will result in more employment than another. Nuclear is an economically viable form of low carbon electricity generation even when the costs of decommissioning and waste disposal are taken into account.

Government's preferred alternative

3.6.12 The Government believes that having new nuclear power stations could significantly reduce the costs of meeting emissions reductions targets especially if CCS is not available at reasonable cost in the future.

3.7 Health and safety (population, human health)

Generic impacts

3.7.1 There are generic occupational health and safety risks associated with large scale construction of any kind of energy infrastructure. However, these can be appropriately managed through health and safety measures and there is legislation in place to regulate this. During construction, there are likely to be emissions to air from traffic and construction activity (including dust) and noise - all of which can have an adverse impact on health. However these effects can be mitigated through the development process, for example, by using cleaner fuels in construction equipment, damping down the construction site on a regular basis to minimise dust, quieter plant selection and limitation of construction working hours to minimise noise.

[102] The Committee on Climate Change (Dec 2008) *Building a low-carbon economy*, Chapter 5, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

[103] The Committee on Climate Change (Dec 2008) *Building a low-carbon economy,* Chapter 5, http://www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

Nuclear NPS

3.7.2 The Nuclear NPS would result in new nuclear power stations being constructed. This would increase the risk of exposure to ionising radiation for workers and the public (compared to the options of *NPS that prohibits nuclear* and *No NPS*). However, this risk needs to be set in the context of overall levels of radiation, and the regulatory regime which minimises the release of radioactivity from nuclear power stations. Taking these factors into account the Government's view is that the risk of detriment to health from new nuclear power stations is very low. The overall average annual dose to a member of the public from all sources of radioactivity is 2.7 millisieverts (mSv) per year. Of this, about 84% is from natural sources, about 15% from medical procedures and about 1% from all other sources, including existing nuclear power stations[104].

3.7.3 Release of radioactivity from nuclear power stations is strictly limited by regulation. By law, the radiation to which members of the public are exposed from all sources, excluding natural sources and medical procedures, is limited to 1 mSv per year.[105] This limit applies to the cumulative effects of planned exposures and therefore takes into account the cumulative impact of having more than one source of radiation in a particular area.

3.7.4 The Health Protection Agency (HPA) has said that a dose of 1 mSv per year is equivalent to an additional risk of fatal cancer of one in twenty thousand (0.005%) per year, and that a risk at this level is not detectable among normal background levels of cancer risk.[106]

3.7.5 However, the regulatory regime goes further than the legal 1 mSv limit. It requires operators to use BAT (Best Available Techniques) and ensure that the resulting exposures are below the statutory limits and as low as reasonably achievable (ALARA). The environment agencies run monitoring programmes to provide an independent check on the impacts of radioactive discharges, and publish annual reports[107] which show that radiation doses to people living around nuclear sites remain well below 1 mSv per year.

3.7.6 In addition to the legal limit, the HPA recommends that the radiation to which members of the public are exposed from a proposed controlled source, such as a new nuclear power station, should be no more than 0.3 mSv per year, and that dose constraints lower than this should be set where this is achievable.

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[104] S J Watson, A L Jones, W B Oatway and J S Hughes (May 2005) *HPA-RPD-001 – Ionising Radiation Exposure of the UK Population: 2005 Review* http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1247816567393

[105] This is through the Ionising Radiations Regulations 1999, Statutory Instrument 1999 No. 3232 (which includes all activities carried out under a nuclear site licence granted by the Nuclear Installations Inspectorate under the Nuclear Installations Act 1965) http://www.opsi.gov.uk/si/si1999/19993232.htm, the Environmental Permitting (England and Wales) Regulations 2010 http://www.opsi.gov.uk/si/si2010/uksi_20100675_en_1, and the Radioactive Substances (Basic Safety Standards) (Scotland) Regulations 2000 http://www.opsi.gov.uk/legislation/scotland/ssi2000/20000100.htm

[106] S Mobbs, S Watson, J Harrison, C Muirhead and S Bouffler (June 2009) *HPA-RPD-055 – An Introduction to the Estimation of Risks Arising from Exposure to Low Doses of Ionising Radiation* http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1245052106074

[107] RIFE (Radioactivity in Food and the Environment) Reports, produced jointly by the Environment Agency, SEPA, DOENI and Food Standards Agency. See in particular Table S1 "Radiation doses due to discharges of radioactive waste in the United Kingdom, 2008" and Table S2 "Radiation doses due to all sources at major UK sites, 2008". http://www.food.gov.uk/multimedia/pdfs/publication/rife2008.pdf http://www.environment-agency.gov.uk/homeandleisure/110281.aspx

3.7.7 HPA's recommendation is reflected in the Environmental Permitting (England and Wales) Regulations 2010 and the Radioactive Substances (Basic Safety Standards) (Scotland) Direction 2000 issued by Scottish Ministers to the Scottish Environment Protection Agency. These require the agencies to have regard to a maximum dose of 0.3 mSv per year to members of the public from any new source of radioactive discharges and to have regard to a maximum dose of 0.5 mSv per year from any single site.

3.7.8 The safety of nuclear power stations in the UK is secured mainly through the licensing regime established in the Nuclear Installations Act 1965[108]. This regime exists within the international framework for nuclear safety established by the International Atomic Energy Agency (IAEA), and is compliant with international conventions[109].

3.7.9 The UK regulatory regime for the protection of members of the public and employees from the health detriment of radiation exposure is jointly the responsibility of HSE's Nuclear Installations Inspectorate (the NII), the Environment Agency and the Scottish Environment Protection Agency.

3.7.10 HSE, through the NII, regulate the safety of nuclear power stations, as well as facilities for fuel fabrication and enrichment and waste management, throughout their lifecycle, by means of an established licensing and permissioning regime. The environment agencies are responsible for ensuring that new nuclear power station designs meet high environmental standards through using the best available techniques (BAT), consistent with the OSPAR Convention[110].

3.7.11 The establishment of the Generic Design Assessment (GDA) process, run through a Joint Programme Office by the NII, the Office for Civil Nuclear Security (OCNS) and the Environment Agency, has facilitated generic consideration of reactor designs ahead of site-specific licence and environmental permit applications.

3.7.12 The work undertaken to date by the regulators as part of the GDA process has provided an overview of the fundamental acceptability of proposed new nuclear power station designs within the overall UK regulatory regime. At this stage HSE considers that its preliminary view, that there were no safety or security shortfalls that would be so serious as to rule out the eventual construction in the UK of the proposed AP1000 and EPR nuclear reactor designs, remains valid[111], and that the proposed designs would meet UK regulatory dose limits and constraints. The Environment Agency published a consultation[112] on its conclusions in June 2010 and stated that in its view so far a Statement of Design Acceptability could be issued for the designs. The Environment Agency and the HSE continue to assess the two

[108] Nuclear Installations Act 1965 (c.57)
http://www.opsi.gov.uk/RevisedStatutes/Acts/ukpga/1965/cukpga_19650057_en_1
[109] The International Convention on Nuclear Safety – http://www-ns.iaea.org/conventions/nuclear-safety.htm
The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
http://www.iaea.org/Publications/Documents/Conventions/jointconv.html
[110] Convention for the Protection of the Marine Environment of the North-East Atlantic
http://www.ospar. org/html_documents/ospar/html/OSPAR_Convention_e_updated_text_2007.pdf
[111] http://www.hse.gov.uk/newreactors/index.htm
[112] GDA Consultation document for the AP1000 nuclear power plant design by Westinghouse Electric Company LLC
https://consult.environment-agency.gov.uk/file/1352806
GDA Consultation document for the EPR UK nuclear power plant design by AREVA NP SAS and Electricite de France SA
https://consult.environment-agency.gov.uk/file/1353658]

designs, including their safety features, as part of the GDA process and intend to report on their final GDA assessments in 2011.

3.7.13 The Government believes that the GDA and licensing processes will ensure that the regulators are satisfied with the safety, security and environmental implications of the AP1000 before the design is approved for construction and operation in the UK. The Government also believes that the regulatory framework will ensure that industry minimises and manages safety and security risks during and beyond the operational life of any nuclear power stations and that this is supported by the nuclear industry's strong safety and security record in the UK.

3.7.14 The Government is conscious of the significant detriments to health that could result from an accident or terrorist attack at a new nuclear power station. However, the scale of potential damage must be seen in the light of the robust regulatory regime which exists in the UK to prevent accidents and protect against security threats including terrorist attacks. Government and industry have an emergency preparedness framework in place to mitigate health effects in the unlikely event of any accidental release of radiation into the environment.

3.7.15 Under UK law, all employers are responsible for protecting their employees, as well as the public, against exposure to ionising radiations. The Ionising Radiations Regulations 1999[113] require all employers to restrict doses so far as is reasonably practicable and to limit doses to 20 mSv in any calendar year unless the nature of the work makes this impracticable. In this event, the limit may be relaxed to 100 mSv over any consecutive five years with a maximum of 50 mSv in any single year. The UK nuclear industry regularly reports exposure levels for its employees which show that it works well within the legal dose limits, and applies additional stricter constraints on dose.[114]

3.7.16 The findings of some studies, in particular the KiKK study, have suggested a link between nuclear power stations and a higher incidence of cancer. The Government has sought advice from the Committee on Medical Aspects of Radiation in the Environment (COMARE), a scientific advisory committee providing independent authoritative expert advice on all aspects of health risk to humans exposed to natural and man-made radiation[115].

3.7.17 COMARE has published a series of reports on topics related to exposure to radiation. Its view is that there is no evidence for unusual aggregations of childhood cancers in populations living near nuclear power stations in the UK.

3.7.18 COMARE's tenth report[116] considered the incidence of childhood cancer around nuclear installations. These were divided into nuclear power stations and other nuclear sites. The results for the nuclear power stations supported the conclusion that '*there is no evidence from this very large study that living with 25km of a nuclear generating site in Britain is associated with an increased risk of childhood cancer*'.

[113] The Ionising Radiations Regulations 1999 http://www.opsi.gov.uk/si/si1999/19993232.htm
[114] http://british-energy.com/pagetemplate.php?pid=453#health
[115] http://www.comare.org.uk/
[116] COMARE (2005) *Tenth Report. The incidence of childhood cancer around nuclear installations in Great Britain*. http://www.comare.org.uk/documents/COMARE10thReport.pdf

3.7.19 COMARE's tenth report did however conclude that the situation for the other nuclear sites is more complicated. Studies confirmed previous COMARE findings of excess childhood cancers in Seascale near Sellafield, Thurso near Dounreay and around Aldermarston, Burghfield and Harwell. Historically, Sellafield is the UK nuclear site with the largest of all radioactive discharges. COMARE's fourth report[117], which concentrated on Sellafield and childhood leukaemia in Seascale, concluded that '*on current knowledge, environmental radiation exposure from authorised or unplanned releases could not account for the excess' [of leukaemia and other cancers]*.

3.7.20 In its eleventh report[118] COMARE examined the general pattern of childhood leukaemia in Great Britain and concluded that many types of childhood cancers '*have been shown not to occur in a random fashion'. It is also stated that 'The results of analyses ...suggest that there is no general clustering around nuclear installations*.'

3.7.21 The KiKK Study[119] of childhood cancer in the vicinity of German nuclear power plants was published in 2008. It found that there was a correlation between the distance of the home from the nearest nuclear power station at the time of diagnosis and the risk of developing leukaemia before the fifth birthday. However, it also noted that the exposure to ionising radiation in the vicinity of German nuclear power stations was lower by a factor of 1,000 to 100,000 than the exposure to natural background and medical radiation, and that therefore the findings of the study could not be explained in the present state of radiobiologic and epidemiologic knowledge.

3.7.22 An analysis by the German Commission on Radiological Protection concluded that the design of the KiKK study was suitable for analysing risks according to distance but not for establishing a correlation with exposure to radiation from nuclear power plants. It pointed out that the natural radiation exposure within the study area, and its fluctuations, were both greater, by several orders of magnitude, than the additional radiation exposure from the nuclear power plants. The analysis concluded "*If one assumes that the low radiation exposures caused by the nuclear power plants are responsible for the increased leukaemia risk for children, then, in light of current knowledge, one must calculate that leukaemias due to natural radiation exposure would be more common, by several orders of magnitude, than they are actually observed to be in Germany and elsewhere*."[120]

3.7.23 Following the KiKK, COMARE requested that a reanalysis of the UK childhood cancer data used in COMARE's tenth report be carried out using the same methodology as the KiKK study as far as possible. This reanalysis – the Bithell paper[121] – was published in December 2008. It showed that, for the UK, the conclusions of the COMARE tenth report remained valid when applying methodology closer to that of the KiKK study on the same dataset.

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[117] http://www.comare.org.uk/documents/COMARE1-6reports.pdf

[118] COMARE (2006) *Eleventh Report. The distribution of childhood leukaemia and other childhood cancer in Great Britain 1969–1993*. http://www.comare.org.uk/press_releases/documents/COMARE11thReport.pdf

[119] Epidemiological Study on Childhood Cancer in the Vicinity of Nuclear Power Plants (KiKK Study). http://www.bfs.de/en/bfs/druck/Ufoplan/4334_KIKK.html
English translation starts after page xi of http://www.bfs.de/de/bfs/druck/Ufoplan/4334_KIKK_Zusamm.pdf

[120] Commission on Radiological Protection (SSK) (2008). Assessment of the "Epidemiological Study on Childhood Cancer in the Vicinity of Nuclear Power Plants" (KiKK Study). Position of the Commission on Radiological Protection. SSK, Bonn, 2008 http://www.ssk.de/en/werke/2008/volltext/ssk0806e.pdf

[121] Bithell et al (2008) *Childhood leukaemia near British nuclear installations: methodological issues and recent results*, *Radiation Protection Dosimetry* http://rpd.oxfordjournals.org/cgi/content/abstract/132/2/191

3.7.24 The KiKK study gave the results on childhood cancer in the vicinity of 16 German nuclear power plants from a dataset established by the German Childhood Cancer Registry, which included over 1500 childhood cancer cases from 1980 to 2003. In comparison, the dataset used for COMARE's tenth report and the subsequent Bithell paper contained over 32,000 cases of childhood cancer from 1969 to 1993. This is a verified national database and is believed to be the largest national database on childhood cancer in the world. The size of the database used by COMARE therefore gives considerable confidence in the results of the tenth report. COMARE is currrently undertaking a further review of the incidence of childhood cancer around nuclear power stations, with particular reference to the KiKK study and COMARE's 10th and 11th reports. This will be published as COMARE's fourteenth report later this year. COMARE is also keeping the incidence of childhood leukaemia and other cancers in the vicinity of Sellafield and Dounreay under surveillance and periodic review.

3.7.25 Flooding and coastal erosion could have a major bearing on the safety of a nuclear power station. Nuclear power stations are likely to be sited on coastal or estuarine locations because of the requirements for cooling water. If development of a nuclear power station caused flooding elsewhere, this could have also impacts on health and safety. A developer would have to demonstrate that the site of the nuclear power station could be protected from flooding (including storm surge, tsunami and flash floods) and coastal erosion for the lifetime of the site, taking into account the effects of climate change.

3.7.26 European Council Directive 96/29/Euratom of 13 May 1996 (the Basic Safety Standards Directive) requires Member States to 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. This process is known as Regulatory Justification and the Secretary of State for Energy and Climate Change, after public consultation, has decided that two nuclear reactor designs, Westinghouse's AP1000 and Areva's EPR, should be Justified[122] .

3.7.27 The Government therefore believes that the regulatory regime will effectively limit and minimise the radiation dose and release of radioactivity from new nuclear power stations, until they have been fully decommissioned, to very low levels, and that the health detriments associated with the operation of new nuclear power stations will be very low.

NPS that prohibits Nuclear

3.7.28 If there is no nuclear power, CCGT power stations are likely to be built instead, and with some renewables. Noise from wind turbines is localised and can be mitigated through careful planning and design. CCGT power stations emit NOx which is a contributor to ground level ozone, which can cause respiratory problems. However NOx emissions will need to be within legal limits and there is a system of regulation in place to minimise health risks.

[122] www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/new/reg_just/reg_just.aspx

No NPS

3.7.29 In this scenario, the impacts are likely to be similar to the Nuclear NPS scenario and NPS that prohibits Nuclear options. New nuclear power stations could still be built although there could be fewer. There could also be some CCGT power stations and some renewables although it is difficult to predict how much of each type would be built.

3.7.30 Flooding and coastal erosion could have a major bearing on the safety of any nuclear power station which are built under this option. Nuclear power stations are likely to be sited on coastal or estuarine locations because of the requirements for cooling water. If development of a nuclear power station caused flooding elsewhere, this could have also impacts on health and safety. A developer would have to demonstrate that the site of the nuclear power station could be protected from flooding (including storm surge, tsunami and flash floods) and coastal erosion for the lifetime of the site, taking into account the effects of climate change.

Summary Findings of the AoS

3.7.31 The generic health and safety impacts from construction and non-radioactive emissions to air during construction and decommissioning would be broadly similar for all three options. The scale of impacts would depend upon the size of development. In terms of the risk posed by radioactive emissions, the system of regulation in place in the UK means that new nuclear power stations (under the Nuclear NPS and No NPS options) would pose a very small risk to health.

Government's preferred alternative

3.7.32 The Government's preferred alternative is to take forward the Nuclear NPS. The Government believes that the risks to health from routine and accidental radioactive discharges are small because of the regulatory system. At a project level, a developer will need to comply with any relevant health and safety legislation to protect workers. They will also need to ensure that routine radioactive discharges are within statutory limits. The developer will also have to demonstrate that the site can be protected from flooding for the lifetime of the site, taking into account the effects of climate change. The developer will also have to demonstrate that the development will not result in unacceptable flood risk elsewhere. This should ensure that the risks to health and safety are minimised.

3.8 Radioactive waste

Generic impacts

3.8.1 New nuclear power stations will produce radioactive waste which needs to be managed. New nuclear power stations will produce low level waste (LLW), liquid and gaseous discharges and non-radioactive wastes. Arrangements already exist for the effective management and disposal of wastes in these categories, as demonstrated by the experience of dealing with such wastes from existing nuclear power stations.

3.8.2 New nuclear power stations will also produce higher activity wastes, which are intermediate level waste and spent fuel (on the assumption that spent fuel from new nuclear power stations will not be reprocessed). Geological disposal is the way

higher activity wastes will be managed in the long term. This will be preceded by safe and secure interim storage until a geological disposal facility can receive waste. The framework to implement this policy was set out in the Managing Radioactive Waste Safely (MRWS) White Paper published in June 2008[123].

3.8.3 Radioactive waste will need to be transported. The UK has robust legislative and regulatory systems in place for the transport of radioactive wastes, including higher activity wastes. Transport of radioactive wastes is, and will continue to be, required to meet a number of national and international requirements to ensure the safety and security of such materials.

Nuclear NPS

3.8.4 The Nuclear NPS would facilitate the construction of new nuclear power stations. This would mean that radioactive waste would be produced (in addition to radioactive waste from existing stations) and would have to be managed.

3.8.5 The sustainability of the arrangements for managing radioactive waste, spent fuel and hazardous wastes from new nuclear power stations is appraised in Chapter 6 of this Main AoS Report which considers the following waste streams:

- Spent Fuel
- Intermediate Level Waste (ILW)
- Low Level Waste (LLW)
- Gaseous and Liquid Radioactive Discharges
- Non Radioactive Hazardous Wastes

3.8.6 The effects of waste management may arise at a nuclear power station site or offsite at other locations where packaging, storage or disposal of waste may be undertaken. There may also be effects associated with the transport of waste between nuclear power stations and waste management sites.

3.8.7 In line with Government policy on the management of higher activity waste, this appraisal considers a Geological Disposal Facility (GDF) as the final destination for spent fuel and ILW. However, the appraisal presented in this section is not a detailed assessment of this facility. It is expected that as the concept design and location are finalised, Strategic Environmental Assessments and Environmental Impact Assessments[124] for a GDF will be completed.

NPS that prohibits Nuclear

3.8.8 The NPS that prohibits Nuclear would mean that no new radioactive waste would be produced.

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[123] Defra, BERR and the Devolved Administrations for Wales and Northern Ireland (June 2008) *Managing Radioactive Waste Safely: A Framework for Implementing Geological Disposal*, www.decc.gov.uk/mrws

[124] NDA Consultation on a Framework for Sustainability Appraisal and Environmental Assessment for Geological Assessment , www.nda.gov.uk/documents/upload/NDA-Consultation-on-a-Framework-for-Sustainability-Appraisal-and-Environmental-Assessment-for-Geological-Disposal-August-2008.pdf

No NPS

3.8.9 The No NPS option would mean that some nuclear power stations might still be developed. These would produce radioactive waste which would need to be managed.

Summary findings of the AoS

3.8.10 The Appraisal of Sustainability has identified potential effects associated with waste arising from new nuclear power stations. In particular some potential negative effects have been identified associated with the management of spent fuel and ILW requiring interim storage at nuclear power station sites. However, these effects are considered to be of minor strategic significance and similar in nature to the effects produced by other aspects of new power station development.

3.8.11 One minor negative effect from the management of spent fuel, which is considered to be of potentially greater significance, is the effect on flood risk. This arises from the possible need to design and maintain flood protection measures for the life of the interim storage of spent fuel, which may extend the lifetime of the site beyond what would otherwise be required.

3.8.12 However, there may be an option to remove spent fuel from power station sites for interim storage at an offsite facility before it is disposed of in a GDF. If interim storage is provided at power stations, it may be possible to mitigate the effects on flood risk through appropriate design, construction and management of flood protection measures.

3.8.13 In the event that there is a substantial number of new nuclear power stations built in the UK, the UK inventory of spent fuel will increase, but will depend on the number of new nuclear power stations constructed and operated. As an illustration, estimates of the amount of spent fuel that would be generated by a 10GW programme of new power stations operating for 60 years indicate that this would increase by between 50-55% the area of a GDF required for spent fuel and High Level Waste (HLW). An existing framework is in place to manage the legacy inventory, and this framework will need to take account of wastes from any new nuclear power stations. It is recognised that some impacts cannot be fully disassociated from the development and implementation of strategies to address UK legacy radioactive waste, and a new build programme may integrate into these where appropriate.

3.8.14 The UK Nuclear Industry LLW Strategy[125] may have a positive influence by reducing legacy waste volumes, and also in facilitating the management of predicted LLW arising from the new nuclear power stations.

3.8.15 The appraisal also notes that the impacts associated with interim storage facilities for ILW, spent fuel and a GDF will be fully assessed as part of project level EIAs once site specific designs and proposals are developed.

[125] UK Nuclear Industry LLW Strategy http://www.nda.gov.uk/loader.cfm?csModule=security/getfile&pageid=29908

Government's preferred alternative

3.8.16 Having considered this issue, the Government is satisfied that effective arrangements will exist to manage and dispose of the waste that will be produced from new nuclear power stations. From time to time, new evidence and material relevant to the disposal of wastes from new nuclear power stations may come to light. The Government will therefore keep the waste assessment under review and will consider whether any new evidence or material provide grounds for revisiting the conclusions.

3.9 The natural environment (biodiversity, flora, fauna, air, landscape)

Generic impacts

3.9.1 All electricity generating technologies result in effects upon the natural environment. These effects will vary depending upon the particular technology, where it is situated and the size of the development. The impacts described below are applicable in all three options of Nuclear NPS, NPS that prohibits Nuclear and No NPS.

3.9.2 Some of these effects are short term and common to all types of infrastructure. During construction, there are likely to be emissions from traffic and construction activity, including dust (which can have an adverse impact on air quality) and noise. However, these effects can be mitigated through the development process, for example by using cleaner fuels in construction equipment, damping down the construction site on a regular basis to minimise dust, and by quieter plant selection and limitation of construction working hours to limit noise.

3.9.3 All thermal power stations (nuclear power, gas, oil, coal) require cooling – either through cooling towers or cooling water. Where cooling water is used, large volumes are extracted and the water is discharged back. Cooling water can have adverse impacts both through abstraction of water and discharge. Abstraction may result in fish being entrained with the cooling water although there are technologies available to mitigate this.

3.9.4 When water is discharged back from the power station, it can affect aquatic ecosystems when the water pumped out is warmer than the receiving water body or if the salinity level is different – this may result in changes to the aquatic ecology through death of organisms or reduction in dissolved oxygen concentrations. Cooling water may also contain low doses of biocide at certain periods of the year to prevent fouling of the cooling water pipelines by molluscs and vegetation. Biocides can change aquatic ecology through the death of non-target organisms.

3.9.5 There is a regulatory framework in place to minimise the risks of adverse impacts of water abstraction and discharge on the environment.

3.9.6 To protect the power station sites against flood risk, new coastal and fluvial flood defence assets may be required. These may modify coastal and estuarial hydrodynamics and sediment transport with attendant ecosystem impacts. Onshore wind generation has little, if any, impact upon water. Flood defences require planning consent and there may be conditions attached to the granting of consent, including the possible need for mitigation and compensation for impacts on the natural environment.

3.9.7 Construction of any type of power station and ancillary infrastructure (such as transmission lines and pylons) has the potential to have an adverse impact on biodiversity and ecosystem services. Construction activities could lead to noise and visual disturbance which could, for example, have an adverse impact on breeding birds. There could be loss, alteration, fragmentation or damage to habitats through direct land take. There are methods to avoid or reduce significant ecological impacts which will be explored at the project level, when the applicant has detailed information to design a bespoke package of mitigation measures tailored to suite local ecological conditions.

3.9.8 Developers will also need to comply with a number of European Directives which aim to protect the natural environment. These include the Water Framework Directive, the Bathing Water Directive, the Shellfish Water Directive, the Freshwater Fish Directive, the Habitats Directive, the Birds Directive, the Air Quality Directive, the Environmental Noise Directive and Marine Policy Statements.

Nuclear NPS

3.9.9 A Nuclear NPS could, in the short term, result in localised effects on air quality during construction, from traffic and construction activity, including dust which can have an adverse impact on local air quality although these are similar to the effects that would arise if alternative forms of energy development were pursued.

3.9.10 During operation nuclear power stations emit radioactive discharges to air. These discharges are small and must be within regulatory limits[126]. However, during operation, nuclear power stations do not produce significant emissions to air of CO_2, nitrogen oxides (NOx) or particulate matter.

3.9.11 During operation, there may also be some minor emissions caused by ancillary equipment, such as back up diesel generators, but these would only be used intermittently and any emissions would have to be within the required environmental permits. The transport of fuel onto the site and transport of waste off the site would also cause emissions although the number of journeys is likely to be small. Private vehicles used by workers would also cause some small emissions. During decommissioning, there would be effects similar to those caused during construction.

3.9.12 The accidental release of any radioactive emissions into the air could cause a significant adverse impact on the natural environment. However, before a site licence is granted, the regulators would need to be satisfied that the risks associated with accidental releases are as low as reasonably achievable and within the relevant radiological limits.

3.9.13 A Nuclear NPS is likely to result in some adverse impacts on biodiversity and ecosystem services, particularly during the construction and operational phases of new nuclear power stations. This could include impact upon sites of ecological importance through habitat loss, disturbance, reduction in fish migration, changes in water quality (including temperature), potential bioaccumulation and coastal squeeze, although there could also be potential mitigations. A new nuclear power station will require buildings to house the reactor, turbine, generator, cooling water

[126] More information on radioactive discharges can be found on the Environment Agency's website www.environment-agency.gov.uk

pump house or cooling towers, control buildings and service and maintenance facilities[127]

3.9.14 The Nuclear NPS has the potential to result in adverse impacts on water because new nuclear power stations are likely to use cooling water. The extraction of water from the natural environment and discharge of heated cooling water to the environment can affect water quality, biodiversity and fisheries. Nuclear power stations use larger volumes of cooling water than other thermal power stations[128]. Some new designs of nuclear power station have a higher thermal efficiency which may lead to lower cooling water needs[129]. The amount of cooling water required will also depend on the type of cooling system chosen and would be less for cooling towers than for direct cooling. Flood defences for nuclear power stations would need to be in place for longer than at CCGT power stations because of the longer operating and decommissioning timescales of nuclear power stations.

3.9.15 Construction of new nuclear power stations is expected to take 5 or 6 years. The operating lifetime of a new nuclear power station will be around 60 years whilst decommissioning is expected to take around 30 years. On site interim storage of higher activity radioactive wastes may need to continue for about 100 years after the end of power station operation. The operating lifetime of a CCGT power station is around 30 years with decommissioning taking around 18-36 months. The exact impact of the flood defences will depend upon the design, which will not be known until the project level.

NPS that prohibits Nuclear

3.9.16 The NPS that prohibits Nuclear option could also result in short term localised effects, on air quality during construction, which are similar to the Nuclear NPS and No NPS options. Under the NPS that prohibits Nuclear alternative, there would be a gradual reduction in nuclear power stations (closing at the end of their operating lifetimes) which may be replaced by new gas CCGT plant and renewables. One consequence of this would be that, in the long term, more pollutants (relative to the other options) would be released into the atmosphere. This is because CCGT power stations emit CO_2 and NOx (although new technologies may help mitigate this). Renewable technologies, such as wind, do not emit pollutants to air although biomass power stations emit particulate matter and NOx. Biomass power stations also emit CO_2 but are considered carbon neutral because burning the biomass releases the carbon which was stored as the biomass grew. Energy from waste plants is also considered carbon neutral despite emissions of CO_2 although not all fuel for energy from waste power stations is renewable. Private vehicles used by workers at power stations would also cause some small emissions as would transport of materials on and off site during operation.

3.9.17 Similar impacts on biodiversity would also occur in the case of NPS that prohibits Nuclear and the Nuclear NPS because the infrastructure which would be built instead of nuclear power stations could also have adverse impacts on biodiversity and ecosystem services. CCGT power stations have similar impacts to nuclear

[127] DTI (May 2007)*The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*, p149, http://www.berr.gov.uk/files/file39197.pdf
[128] Barsak and Kilpatrick, University of Georgia (2003) *Energy Impacts on Georgia's Water Resources*,
[129] DTI (May 2007) *The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*, p51, http://www.berr.gov.uk/files/file39197.pdf

power stations on biodiversity and ecosystem services. CCGT power stations also require cooling water (unless cooling towers are utilised) and there would be potential impacts from abstraction and discharge of cooling water similar to the impacts under the Nuclear NPS option. However, it should be noted that the volumes of cooling water required by a CCGT power station are less than for an equivalent sized nuclear power station. Renewables generation, such as wind farms, do not require cooling water.

3.9.18 CCGT power stations might also require flood defences to protect the site although they would need to be maintained for shorter period than a nuclear power station because the operating lifetime is shorter

3.9.19 The amount of land take required for one CCGT station is also smaller than the amount of land required for a nuclear power station. A CCGT power station will require permanent buildings for a turbine hall, exhaust gas stacks, storage facilities, cooling water pump house or cooling towers, water processing power station and administrative buildings. Renewables infrastructure, such as wind farms, can require more land than either CCGT power stations or nuclear power stations. The impacts of CCS technology on the natural environment are unknown. Tidal power stations can also have adverse impacts on biodiversity and ecosystem services.

No NPS

3.9.20 The No NPS option would have similar effects to the Nuclear NPS and NPS that prohibits Nuclear options. Nuclear power stations could still be built although there may be fewer. These would have an impact on the natural environment as would any CCGT or renewables which came forward.

Summary Findings of the AoS

3.9.21 During construction and decommissioning, the short term effects on air quality are similar for the three options. However, these are short term, localised, there are possible mitigations and these effects are not considered to be significant.

3.9.22 It is during operation that the differences become apparent. There would be more adverse impacts from the NPS that prohibits Nuclear option because the CCGT stations which are built instead would emit NOx although any renewables infrastructure might not (wind power causes no emissions to air during operation although biomass power stations emit NOx and particulate matter).

3.9.23 The effects on biodiversity and ecosystem services are not significantly different across all three alternatives. All have the potential to adversely impact upon biodiversity and ecosystem services if appropriate mitigations are not put in place.

3.9.24 Similar effects on water are expected for all the alternatives where thermal generation power stations are built, whilst recognising that CCGT power stations require less cooling water than equivalent sized nuclear power stations. This would not be the case for any renewables generation, such as onshore wind, that might result from the NPS that prohibits Nuclear and No NPS options. However, the scale of any impacts would depend upon the size and location and detail of any developments.

Government's preferred alternative

3.9.25 Having considered the findings of the AoS and other information, the Government's preferred alternative is to take forward the Nuclear NPS. With the exception of radioactive waste, the impacts on the natural environment of constructing new nuclear power stations would not be significantly different to constructing CCGT stations or renewables generation. During operation emissions from nuclear power stations would be lower than emissions from CCGT power stations. Therefore the Government believes it should proceed with the Nuclear NPS. At a project level, an Environmental Impact Assessment and Habitats Regulations Assessment will be required when an application for development consent is submitted to the IPC. This will help to ensure that appropriate mitigations are considered and implemented .

3.10 The built environment (landscape, cultural heritage and material assets)

Generic impacts

3.10.1 All types of energy infrastructure have the potential to have an adverse impact on landscape[130] and cultural heritage. The scale of such projects means that they will often be visible within for many miles. The scale and significance of the impact will be determined by the size of the development and the location – for example, a power station in an area of Green Belt land may have more of a visual impact than a power station in an industrial area. The overall size of the development will be dependent upon the technology and design. Cooling towers and exhaust stacks (if these are required) have the most obvious impact on landscape and visual amenity.

3.10.2 There will be short term effects, for example, during construction where earthworks may be required to prepare a site and movements of construction traffic could result in localised noise impacts. These can adversely affect the tranquillity of an area.

3.10.3 Longer term effects will result from the permanent buildings[131] and ancillary infrastructure such as the transmission system which all centralised electricity generation requires. Pylons can be a prominent feature on the landscape.

3.10.4 Energy infrastructure can also have adverse impacts upon cultural heritage. For example, construction works could lead to the direct loss of archaeological remains, an adverse impact upon historic landscapes or changes to the setting of heritage resources. Longer term impacts could result from the presence of a development altering the aesthetics of the surrounding area.

Nuclear NPS

3.10.5 A Nuclear NPS could result in adverse impacts on the landscape and cultural heritage from the short term impacts arising from construction, as described above. Longer term impacts on landscape and cultural heritage could be caused by permanent buildings. For example, one nuclear power station will require buildings to house the reactor, turbine, generator, cooling water pump house or cooling

[130] Landscape in this assessment also includes townscape and seascape
[131] "Permanent building" means a building which will be present for the lifetime of the power station

towers, control buildings and service and maintenance facilities[132]. There could also be new overhead transmission lines and pylons.

NPS that prohibits Nuclear

3.10.6 The NPS that prohibits Nuclear option could also result in similar adverse impacts on landscape if CCGT power stations and renewables infrastructure are built instead. Short term impacts from construction will be similar to the Nuclear NPS option, as will long term impacts. For example, a CCGT station will require, inter alia, permanent buildings for a turbine hall, exhaust gas stacks, cooling water pump house or cooling towers, water processing station and administrative buildings. Gas pipelines would also be required. Biomass generating stations will require more space than other types of power station to store fuel. Space will also be needed for other bulk material storage, such as ash, prior to disposal.

3.10.7 Renewables generating infrastructure can also have an adverse impact on landscape. Modern commercial-scale wind turbines have a tip height of around 130 metres and can have significant impacts on the landscape.

No NPS

3.10.8 The No NPS option would have similar effects to the Nuclear NPS and NPS that prohibits Nuclear options. Nuclear power stations could still be built although there may be fewer. These would have an impact on the built environment as would any CCGT or renewables which came forward.

Summary Findings of the AoS

3.10.9 The impacts on landscape and cultural heritage of the three options would not be significantly different. Nuclear power stations, CCGT power stations and renewable generating infrastructure can all have adverse impacts on landscape and cultural heritage. The size and scale of the impacts will depend upon the size and location of the development. At the project level potential avoidance and mitigations measures would be assessed as part of the application for development consent.

Government's preferred alternative

3.10.10 Having considered the findings of the AoS and other information, the Government's preferred option is to take forward the Nuclear NPS. The Government considers that a Nuclear NPS would not result in significantly worse impacts on landscape and cultural heritage than the options of NPS that prohibits Nuclear and No NPS. The exact scale of the impacts on landscape and cultural heritage, and possible mitigations, will not be known until the project level. Each application for development consent will require an Environmental Impact Assessment where these issues will be explored in more detail.

[132] DTI (May 2007) *The Future of Nuclear Power - The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*, p149, http://www.berr.gov.uk/files/file39197.pdf

3.11 Summary of assessment of Need Alternatives

Overall Findings of the AoS

3.11.1 On balance, and on the basis of the above assessment, the preferred alternative is the Nuclear NPS in line with Government policy. This is based on the case for nuclear power in relation to other alternatives, and the effect it might have on the long-term ability of the UK to meet its emission reduction targets and maintain its security of supply.

Government's preferred alternative

3.11.2 After having considered the sustainability impacts of constructing energy infrastructure in line with a Nuclear NPS, an NPS that prohibits Nuclear and No NPS, the Government has concluded that the **Nuclear NPS is the preferred option to take forward**.

3.11.3 The Government believes that, with the exception of radioactive waste, the environmental impacts of new nuclear power stations would not be significantly different to those of other forms of electricity generation[133]. In terms of CO_2, NOx and particulate matter emissions, the construction and operation of new nuclear power stations in accordance with a Nuclear NPS would result in lower emissions during operation than would result from CCGT power stations built under the NPS that prohibits Nuclear option and any CCGT power stations which came forward under the No NPS option.

3.11.4 The **Nuclear NPS** option would

- not result in significant emissions of CO_2, NOx and particulate matter to the atmosphere;
- improve the UK's security of supply, and reduce the UK's reliance on imported gas;
- deliver low-carbon electricity at least cost, thereby contributing to emissions reduction targets and the fight against climate change;
- not be subject to fossil fuel price volatility; and
- not result in increased risks to health and safety due to the strict regulatory regime in place.

3.11.5 In relation to the radioactive wastes that new nuclear power stations will produce, the Government has set out in that it is satisfied that effective arrangements will exist to manage and dispose of the waste any new nuclear power stations will produce.

3.11.6 The **NPS that prohibits Nuclear** option would:

- make the UK reliant on renewables and fossil fuels with CCS for reducing carbon emissions;

[133] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, p103

- increase the risk of the UK not meeting its carbon reduction targets;
- make the UK reliant on a smaller number of technologies which may undermine security of supply;
- expose the UK to higher risk of electricity supply interruptions; and
- incur higher costs to deliver the same amount of electricity.

3.11.7 New nuclear power stations are needed because:

- nuclear power is a proven technology and has the benefits of being low-carbon with lifecycle CO_2 emissions in the range of 7-22g/kWh, about the same as those of wind generated electricity[134];
- they are capable of increasing diversity and reducing dependence on any one technology or country for our energy or fuel supplies;

3.11.8 Failure to meet this need for new nuclear power generation will increase the risk of the Government not meeting its energy and climate change goals, encompassing economic, environmental and social objectives, which are aimed at achieving a better quality of life for all, now and in the future.

3.11.9 Failure to grant timely development consent for new nuclear power stations would significantly increase the risk of the UK failing to meet its CO_2 reduction targets, because of the greater reliance being placed on fewer technologies, some of which have yet to be proven on a commercial scale[135].

3.11.10 The Government concludes that the **Nuclear NPS** is the option it will take forward.

[134] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, p58, http://www.berr.gov.uk/files/file43006.pdf
[135] BERR (Jan 2008) *Meeting the Energy Challenge: A White Paper on Nuclear Power*, p17, http://www.berr.gov.uk/files/file43006.pdf

Chapter 4. Alternatives assessment for the Nuclear NPS: Process Alternatives

4.1 Process alternatives considered

4.1.1 Having decided to proceed with a Nuclear NPS, the contents of the Nuclear NPS will influence the number, location and timing of any new nuclear build. The Government has a choice about the way in which it develops the Nuclear NPS. The realistic and meaningful options were set out in the Update Report[136] and are summarised as follows:

- B1: a Nuclear NPS that includes siting criteria only and no list of sites;
- B2: a Nuclear NPS that includes a list of sites and no siting criteria;
- B3: a Nuclear NPS that includes siting criteria and a list of sites
- B4: a Nuclear NPS that includes siting criteria and a list of sites but restricts the sites considered to those in the vicinity of existing nuclear power stations.

4.2 What are the process alternatives likely to mean in practice?

4.2.1 A number of assumptions have been made in assessing the likely significant sustainability effects of the four process options for the draft Nuclear NPS

4.2.2 Alternative B1 – the IPC would consider applications for development consent with an NPS which sets out the national need and a list of siting criteria but not the list of nominated sites. This would result in later and smaller scale deployment of new nuclear build than an NPS including a list of sites (Option B3), as it could take longer to bring a site forward for development. It may also reduce the chances of sites being brought forward at all. The inclusion of siting criteria should assist in the identification of suitable sites, but in the absence of a list of potentially suitable sites, strategic, cumulative and synergistic effects would not be assessed. This could lead to the inadequate consideration of alternative sites, with potentially long-term negative effects. Overall, Alternative B1 could result in a greater level of uncertainty about where sites would be developed and would allow less consideration of interactions between sites.

4.2.3 Alternative B2, in which a list of nominated sites is presented without any siting criteria, is likely to result in later and smaller scale deployment of new nuclear build, as planning regulations would require the nominated sites to be subject to a (later) strategic siting assessment. Further, there would be no way of knowing how sites not included would be assessed by Government. Excluding siting criteria may also

[136] DECC (Jan 2009) *Applying the Strategic Siting Assessment Criteria; an update to the study of the potential environmental and sustainability effects*

allow non-suitable sites to be included. However, publishing a list of nominated sites would enable the strategic, cumulative and synergistic effects to be assessed.

4.2.4 Alternatives B3 and B4 represent a Nuclear NPS in which both siting criteria and a list of nominated sites are included; in the case of B4, the list of sites is restricted to those in the vicinity of existing nuclear power stations. It has been assumed that both option B3 or B4 will lead to the earlier and larger scale deployment of new nuclear power stations than would be the case for B1 or B2. This is because the planning process would be shorter, the sites would already have been subject to strategic scrutiny, significant information would already be available, and in the case of B4, there may be local support for development in these areas. The application of siting criteria would also help avoid the selection of those sites which could have adverse sustainability effects. This would also allow for potential cumulative and synergistic effects to be examined, thereby minimising the potential negative effects and maximising the potential positive effects. In the case of B4, this would have long-term positive effects by protecting the natural and built environment, and may allow for the protection of areas that would otherwise have been considered for new nuclear build. Alternative B4 may, however, result in fewer new nuclear power stations being built, as new build could only occur in the vicinity of existing nuclear power stations.

4.3 Findings

4.3.1 The following table summarises the appraisal of the significant sustainability effects of Alternatives B1 to B4. This appraisal has been carried out using the headline SD topics used for the appraisal of needs alternatives in Chapter 3 and which are described in Chapter 2. Table 4.1 identifies the main differences between the process alternatives in the light of the assumptions presented above.

Table 4.1 Likely significant sustainability effects of the process alternatives

Topics	Significant sustainability effects of the process alternatives
Climate Change	In the short-term, construction of nuclear power stations and ancillary developments would lead to an increase in CO_2 emissions (as with constructing any power station). **Alternatives B3** and **B4** will assist the UK in its climate change goals. **Alternative B4** could reduce the need for ancillary development such as new access roads and transmission infrastructure which could, in their construction, lead to increased CO_2 emissions. Alternative B4 could result in greater carbon reduction benefits during the construction phase. Alternative B4 could, however, limit the number of nuclear power stations which might be developed and the amount of low-carbon electricity which is produced in the long-term.
Security of Energy Supply	**Alternative B1** could adversely affect security of supply in the long-term.

Topics	Significant sustainability effects of the process alternatives
	Alternative B2 could adversely affect security of supply in the long-term. **Alternative B3** could have a positive impact on security of supply in the long-term. By reducing the potential number of sites for new nuclear build, **Alternative B4** could adversely affect security of supply in the long-term.
Health and Safety (population, human health)	**Alternative B1** could reduce the level of certainty of the likely human health and well-being effects of developing new nuclear power stations across the UK. For example, it would not be possible to assess the potential effects of a nominated site on the nearby population and communities. However, the UK has strict, independent, safety and environment protection regimes for nuclear power which fulfil the requirements of the Euratom Treaty with regard to radiation protection. Any new nuclear power station will be subject to safety licensing conditions and will have to comply with the safety and environmental conditions set by the regulators in their licences and authorisations. This would apply to all alternatives and would ensure that human health and well-being issues are considered. However, Alternative B1 would not subject them to the same degree of strategic scrutiny. **Alternative B2** could reduce the level of certainty of the likely human health and well-being effects of developing new nuclear power stations across the UK. All sites developed would be subject to the UK's strict regulatory regimes. **Alternative B3** could help to increase certainty and understanding of the likely human health and well-being effects that would occur at a strategic level. However, all sites developed would be subject to the UK's strict regulatory regimes. **Alternative B4** could help to increase certainty and understanding of the likely human health and well-being effects that would occur at a strategic level. This alternative could also result in a better understanding of how human health and well-being had historically been affected at, and in the vicinity of the existing sites. This could help to inform future judgments although these experiences could also be applied when trying to understand the human health and well-being effects of potential locations for new nuclear power stations in entirely new areas.
Radioactive Waste Generation	**Alternative B3** is likely to lead to the earlier and larger scale deployment of new nuclear power stations. This would mean that radioactive waste from the new build programme will begin to be generated at an earlier date and that more radioactive waste in total may be produced, if more nuclear power stations are developed.
The Natural Environment	**Alternative B1** could result in adverse long-term effects on the natural environment and reduce the level of certainty about the

Topics	Significant sustainability effects of the process alternatives
	effects that are likely to be the most significant. **Alternative B2** could result in new nuclear build being located at inappropriate sites which could have long-term negative effects on the natural environment. **Alternative B3** could have long-term positive effects by helping to protect the natural environment. **Alternative B4** could have long-term positive effects for the natural environment. The development of new nuclear power station sites at or in the vicinity of existing sites might help to reduce some of the adverse environmental effects on the natural environment that could occur if sites other than existing nuclear power stations were selected. This could also lead to indirect protection of other areas of value at other locations across the UK, by focusing further development around existing sites. However, since the development of some of the existing nuclear power station sites, some additional internationally and nationally designated ecological sites have been identified. Careful design and siting would be needed to ensure that adverse effects did not occur as a result of the construction of new nuclear power stations at the existing sites. There could also be a greater likelihood of brownfield rather than greenfield sites being developed which would help to reduce the likelihood of loss of biodiversity, infiltration capacity and the introduction of contamination into such areas.
The Built Environment	**Alternative B1** could provide less direction to the IPC in terms of strategic site suitability. This could increase development costs as there would still be a need to assess strategic suitability issues when development consent is sought for individual sites. While this alternative would not prevent a developer from putting forward a planning application on an individual site, there may be advantages in terms of greater planning certainty and reduced risk in putting forward a planning application on a site which is listed in the Nuclear NPS. This option may also result in adverse long-term effects on landscape and cultural heritage and reduce the level of certainty about the effects that are likely to be the most significant. **Alternative B2** could reduce uncertainty for developers, and may also reduce the burden on the IPC when they have to make decisions about site specific applications for development consent, as the sites developed would be listed in the Nuclear NPS. This could also result in new nuclear build being located at inappropriate sites which could have long-term negative effects on landscape and cultural heritage. **Alternative B3** could have benefits as it would reduce the burden on the IPC, thereby reducing the length and cost of planning inquiries, as the sites likely to be developed would be listed in the Nuclear NPS. Early assessment of specific sites listed on the NPS

Topics	Significant sustainability effects of the process alternatives
	could also have long-term positive effects by helping to identify and protect the landscape and cultural heritage. **Alternative B4** could potentially reduce the capital cost involved in developing new nuclear power stations for developers. This alternative, by including a list of sites in the NPS, could also potentially help reduce uncertainty for developers and may reduce the burden on the IPC when they have to make decisions about site specific applications for development consent, as the sites would be listed in the NPS. The use of existing sites could result in a greater degree of certainty about the effects on the landscape and cultural heritage because there would be an understanding of how the environment had previously been affected by such development. This could help also to protect other areas of the UK from being disturbed by such development and the overall landscape effect might be reduced, as the focus would be on developing those areas of land that had already been affected by existing nuclear power stations. Availability of sites is a key issue for developers seeking to build new nuclear power stations in the UK.

4.3.2 On the basis of the above assessment, the preferred alternative is B3. This alternative combines siting criteria and a list of nominated sites and would therefore provide a structured and robust means of subjecting potential new nuclear power station sites to strategic scrutiny and sustainability appraisal. Further, an assessment of alternative sites would be undertaken, and the publication of a list of potentially suitable sites would enable the potential cumulative and synergistic effects of the sites to be assessed. In addition, the list of sites would have undergone a strategic level assessment which could reduce the likelihood of adverse sustainability effects occurring and provide a means of enabling such effects to be avoided or mitigated.

4.3.3 This would reduce uncertainty and the length of time needed for a planning application as it would list sites which have been assessed at a strategic level. This would also allow for greater and earlier new nuclear build thereby contributing to meeting the Government's climate change and security of supply objectives at least cost.

4.3.4 Alternative B4 uses the same approach as Alternative B3 but would apply the criteria only to existing nuclear power station sites. We recognise that there are significant sustainability benefits associated with taking only existing sites forward in terms of the ancillary developments needed. However, by limiting new nuclear power stations to existing sites, some potentially suitable sites could be excluded from the selection process leading to an incomplete assessment of alternative sites. In addition, competition may be restricted in nuclear energy generation, which could lead to inefficiencies.

4.3.5 Therefore, the Government concluded that a draft Nuclear NPS should be developed in line with Government policy and that the Nuclear NPS should take the form of Option B3 and include siting criteria and a list of sites. The following Chapter 5 sets out how the Government has considered where nuclear power stations should be located.

Chapter 5. Location Alternatives

5.1 Introduction

5.1.1 Government has considered where new nuclear power stations should be located through the SSA process. Sites were nominated by third parties and the Government assessed them against exclusionary and discretionary criteria and taken account of the AoS and HRA reports in reaching a decision about their potential suitability. The AoS reports for the sites considered potentially suitable by the SSA process are set out in Annexes A to H.

5.1.2 It was considered that the criteria themselves constituted reasonable alternatives with regard to the SEA Directive and therefore, the draft criteria were subject to AoS using the framework of AoS objectives. The findings of this appraisal were reported in the Environmental and Sustainability Report[137] in July 2008. Three criteria for the SSA were amended as a result of the public consultation and these were reappraised using the AoS framework and reported in the Update Report[138] in January 2009. The SSA process is summarised here in this AoS report and the findings of the AoS of the criteria are also summarised within this AoS report.

5.2 Findings of the AoS

The Strategic Siting Assessment process and criteria

5.2.1 The SSA was developed for identifying and assessing the strategic suitability of nominated sites for the deployment of new nuclear power stations by the end of 2025. The SSA process comprised a number of stages:

- development of the SSA criteria and the process for identifying and assessing potentially suitable sites;
- third parties were invited to nominate sites which they considered to be suitable for the construction of new nuclear power stations; and
- nominated sites were assessed for potential suitability using the SSA criteria.

5.2.2 The proposals for the SSA process and the draft SSA criteria were subject to public consultation in July 2008 and an environmental and sustainability study that appraised the potential effects of the draft SSA criteria was also published.

5.2.3 The draft proposed SSA criteria comprised a list that were variously exclusionary, discretionary or flagged for local consideration summarised as follows:

- criteria related to nuclear safety: seismic risk: capable faulting; flooding; tsunami, storm surge, coastal processes; proximity to hazardous facilities and

[137] BERR (July 2008) *Applying the proposed Strategic Siting Assessment Criteria: A study of the potential environmental and sustainability effects*
[138] DECC (Jan 2009) *Applying the Strategic Siting Assessment Criteria; an update to the study of the potential environmental and sustainability effects*

operations; proximity to civil aircraft movements; demographics, proximity to military activities;

- criteria related to environmental protection: internationally and nationally designated sites of ecological importance;
- criteria related to operational requirements: size of site; access to suitable sources of cooling water;
- local criteria related to nuclear safety: non-seismic ground conditions; meteorological conditions; proximity to civil aircraft movements, mining, drilling and other underground operations; emergency planning;
- local criteria related to societal issues: significant infrastructure/resources; and
- local criteria related to operational requirements: access to transmission infrastructure.

Appraisal of environmental and sustainability effects

5.2.4 The Scoping Report (March 2008) set out the proposed framework for appraisal including a review of relevant plans and programmes, the baseline situation against which the appraisal would be made, and a list of SEA objectives and decision aiding questions that would be used to consider the likely effects of the proposed SSA criteria on environmental and sustainability factors relevant to the development of a draft Nuclear NPS. The framework of objectives for the appraisal was set out previously in Chapter 2 in tables 2.2 to 2.6.The details of the findings of the appraisal are set out in the Environmental and Sustainability Report (July 2008). It was acknowledged that the appraisal was a strategic assessment since at that stage it was not known where new nuclear power stations might be built. The main findings of the study were reported in two ways:

- effects of the collective proposed SSA criteria on each environmental/sustainability objective; and
- effects of the individual proposed SSA criteria on each environmental/sustainability objective.

5.2.5 Where any likely significant adverse effects were identified, the study suggested measures to mitigate the effects by amendments to the wording of the criteria, proposals to remove or add new criteria, and considerations to be taken into account at a later stage when the sites were nominated.

5.2.6 The studies concluded that:

- the proposed SSA criteria were broadly in line with sustainability and environmental objectives;
- the discretionary nature of some criteria means that adverse environmental effects cannot be ruled out at the strategic level; and

- certain local level impacts are not addressed by the SSA but it is made clear that these would be addressed through EIAs accompanying individual planning applications.

The Update Report

5.2.7 As a result of the public consultation responses, the Government made a small number of amendments to the proposed SSA criteria. Generally these changes related to a change in classification, for example, from a national exclusionary criterion to one that will be considered at the local level. It was considered that some criteria are more appropriately assessed at the local level, recognising that assessment at the strategic level is not capable of adequately addressing these issues.

5.2.8 The key amendments to the SSA criteria proposed as a result of the consultation were as follows:

- size of site to accommodate operation: previously included size of site to accommodate construction and decommissioning which was amended to be flagged for local consideration;
- seismic risk (vibratory ground motion): change from exclusionary to flag for local consideration;
- capable faulting: change from exclusionary to flag for local consideration; and
- tsunami, storm surge and coastal processes; tsunami and storm surge to be merged with flood risk and coastal processes to become a separate criterion.

5.2.9 These amended SSA criteria were appraised strategically using the environmental and sustainability objectives and the sustainability effects of the changes were generally found to be neutral or minor. Therefore, it was concluded that the changes did not materially change the conclusions reached in the environmental and sustainability study that the proposed SSA criteria are broadly in line with the principles.

5.3 The AoS of sites included in the revised draft NPS

5.3.1 The 11 sites that were nominated into the SSA were assessed against exclusionary and discretionary criteria, as well as being subject to an AoS and HRA. One nominated site, Dungeness, did not pass the SSA discretionary criterion on international sites of ecological importance and there were also concerns about flood risk and coastal processes though the site did pass those criteria. The Government therefore decided that Dungeness was not potentially suitable and it was not included in the draft Nuclear NPS published for consultation in November 2009 to February 2010.

5.3.2 The Government also commissioned an Alternative Sites Study[139] to ensure that potential alternative sites were given due consideration. The study drew on a

[139] Atkins Ltd for DECC (2009) *A consideration of alternative sites to those nominated as part of the Government's Strategic Siting Assessment process for new nuclear power stations*, http://data.energynpsconsultation.decc.gov.uk/documents/atkins.pdf

number of information sources to identify sites that might be "*worthy of further consideration*" by the Government to determine whether these sites were likely to meet the SSA criteria. Three sites were identified through this process; Druridge Bay in Northumberland, Kingsnorth in Kent, and Owston Ferry in Lincolnshire. A site AoS and site HRA was undertaken for each of these sites[140]. The Government concluded that none of these three sites should be considered as reasonable alternatives to the sites that have been nominated because they were not deployable by the end of 2025, and they were not included in the initial draft Nuclear NPS.

5.3.3 The 10 sites that were considered potentially suitable were included in the initial draft Nuclear NPS for public consultation in November 2009 to February 2010. Following the consultation, the Government has concluded that the sites at Braystones and Kirksanton are not potentially suitable because of the likelihood of deployability by the end of 2025 and the assessment against the criterion on areas of amenity, cultural heritage and landscape value *(*including potential impacts on the Lake District National Park). The Government confirms that the site at Dungeness remains unsuitable. Therefore, the revised draft Nuclear NPS sets out a list of eight sites that are considered potentially suitable for the deployment of new nuclear power stations by the end of 2025. The findings of the site level appraisals for these eight sites are set out in the site level AoS Reports (Annexes A – H) and are summarised in Chapter 7 of this revised Main AOS Report. The assessments of the three sites that are not considered potentially suitable are available at www.energynpsconsultation.decc.gov.uk.

[140] These reports are available at www.energynpsconsultation.decc.gov.uk

Chapter 6. Radioactive waste, spent fuel and hazardous waste

6.1 Introduction

6.1.1 The revised draft Nuclear NPS sets out the Government's view that effective arrangements will exist to manage and dispose of the radioactive waste that will be produced from new nuclear power stations.

6.1.2 New nuclear power stations will produce a range of different waste streams. Assuming that there will be no reprocessing of spent fuel from new nuclear power stations, the revised draft Nuclear NPS identifies "*higher activity wastes*" as being spent fuel and intermediate level waste (ILW). New nuclear power stations will also produce other waste streams: low level waste (LLW), liquid and gaseous discharges and non-radioactive wastes.

6.1.3 This chapter of the AoS appraises the sustainability of the arrangements for managing both the higher activity wastes and other radioactive and hazardous wastes and considers the following waste streams:

- Spent Fuel
- Intermediate Level Waste (ILW)
- Low Level Waste (LLW)
- Gaseous and Liquid Radioactive Discharges
- Non Radioactive Hazardous Wastes

6.1.4 The management of non-radioactive, non-hazardous waste is detailed in the site level AoSs (see Annexes A - H) under the AoS topic for Communities: Supporting Infrastructure. The key findings are summarised in Chapter 7 of this Main AoS report under this topic.

6.1.5 The findings of the appraisals of sustainability of the management of radioactive waste, spent fuel and hazardous wastes are summarised in this chapter and are supported by additional technical information on waste management that is included in Annex I that accompanies this AoS report. Each waste stream is appraised in turn and any recommendations in relation to management of radioactive or hazardous wastes are presented at the end of each section. These recommendations are repeated in the section of Chapter 7 that deals with radioactive and hazardous waste.

6.1.6 In the absence of reprocessing, spent fuel is considered to be waste for the purposes of this appraisal. The impacts of radioactive wastes that may arise from new nuclear power stations are dependent on the inventory of wastes generated. An estimate of the inventory of radioactive waste arising from new nuclear power

stations and the legacy waste already generated is presented in Annex I Appendix A – Baseline information[141].

6.1.7 The management of radioactive waste, spent fuel and hazardous waste is a cross-cutting activity and there may be effects on a number of the objectives for sustainability as defined within the AoS framework (detailed previously in section 2.4 of this AoS report). The appraisal of each of the waste streams has been undertaken using the sustainable development topics and AoS objectives set out in Table 2.2.

6.1.8 The effects of waste management may arise at a nuclear power station site or offsite at other locations where management or disposal of waste is undertaken. There may also be effects associated with the transport of waste between nuclear power stations and waste management sites. The current appraisal has distinguished between effects arising at nuclear power stations and in the course of transport of waste from these sites and those effects arising at the locations where waste is disposed of. This distinction is intended to assist in separating:

- effects arising at nuclear power stations or in the transport of waste from them that are relevant to the revised draft Nuclear NPS and that have led to recommendations for further consideration by the IPC when considering applications for development consent for new nuclear power stations; and
- effects arising at the locations where waste is disposed of offsite, that are noted for the consideration of those responsible for the design and consenting processes for these waste management facilities.

6.1.9 In line with Government policy on the management of higher activity waste, this appraisal considers a Geological Disposal Facility (GDF) as the final destination for spent fuel and ILW. However, the appraisal presented in this section is not a detailed assessment of this facility. It is expected that as the concept design and location are finalised, an SEA and EIA[142] for a GDF will be completed.

6.2 Policy Context

6.2.1 This section considers the UK policy context as it relates to radioactive waste. It identifies key significant policy objectives at the national level that need to be considered for the strategic appraisal of radioactive waste. Annex K: Appendix B[143] presents a summary of the significant national and international policy and legislation in relation to radioactive and hazardous waste and provides context to the AoS of waste. The key sustainability objectives drawn from this review of relevant plans, programmes and environmental objectives are summarised in Tables 6.1 that need to be taken into account during the AoS for each of the waste streams considered.

[141] www.energynpsconsultation.decc.gov.uk
[142] NDA (2009) *Geological Disposal: A strategy for sustainability appraisal and environmental assessment*. http://www.nda.gov.uk/documents/upload/Geological-Disposal-A-Strategy-for-Sustainability-Appraisal-and-Environmental-Assessment-July-2009.pdf
[143] www.energynpsconsultation.decc.gov.uk

Table 6.1 Key sustainability objectives for waste management

Relevant national policy documents	Key objectives for sustainability
Spent Fuel	
• The Future of Nuclear Power[144] • MRWS White Paper[145] • Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations[146]	• Safe and secure interim storage systems that are technically capable of being maintained or replaced to last for at least 100 years from the time the waste is first emplaced[147]
Intermediate level waste (ILW)	
• The MRWS White Paper [148] • Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations [149] • The Future of Nuclear Power [150]	• Safe and secure interim storage systems that are technically capable of being maintained or replaced to last for at least 100 years from the time the waste is first emplaced[151] • Application of the waste management hierarchy[152]
Low level waste (LLW)	
• Policy for Long-Term Management of Solid LLW in the United Kingdom[153] • Low Level Waste: Nuclear Industry LLW Strategy[154]	• Application of the waste management hierarchy[155] • Preservation of disposal capacity at Low Level Waste Repository in west Cumbria • Application of BPEO/BPM or BAT[156] to reduce waste arisings
Liquid and gaseous radioactive discharges	
• Establishment of Basic Safety Standards[157]	• Dose limit of 1mSv/y to the public from all manmade sources of radioactivity

[144] http://www.berr.gov.uk/files/file39197.pdf
[145] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal www.decc.gov.uk/mrws
[146] Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations http://www.berr.gov.uk/files/file44486.pdf
[147] http://www.berr.gov.uk/files/file44486.pdf It should be noted that operators will be obliged to maintain their interim stores until the date or dates specified in the schedule agreed with the Government for when the Government will take title to and liability for each operator's intermediate level waste and spent fuel. In any event, the Government considers that waste can and should be stored in safe and secure interim storage facilities until a geological disposal facility becomes available.
[148] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.decc.gov.uk/mrws
[149] Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations http://www.berr.gov.uk/files/file44486.pdf
[150] http://www.berr.gov.uk/files/file39197.pdf
[151] http://www.berr.gov.uk/files/file44486.pdf It should be noted that operators will be obliged to maintain their interim stores until the date or dates specified in the schedule agreed with the Government for when the Government will take title to and liability for each operator's intermediate level waste and spent fuel. In any event, the Government considers that waste can and should be stored in safe and secure interim storage facilities until a geological disposal facility becomes available.
[152] 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
[153] http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/nuclear/radioactivity/llw-policystatement070326.pdf
[154] 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
[155] 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
[156] The Government through guidance to the EA is replacing BPM / BPEO in England and Wales with Best Available Techniques (BAT)

Relevant national policy documents	Key objectives for sustainability
• Environmental Permitting (England and Wales) Regulations 2010 • UK Strategy for radioactive discharges[158] • OSPAR Commission, The Convention for the Protection of the Marine Environment of the North-East Atlantic[159]	• The conservation of the marine ecosystems and safeguarding of 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
Non-radioactive hazardous waste	
• Nuclear Sector Plan[160] • Waste Strategy for England[161] • National Waste Strategy for Wales[162]	• Minimise and manage solid waste[163] • Secure investment in infrastructure needed to divert waste from landfill and for the management of hazardous waste[164]

6.3 Appraisal of sustainability

6.3.1 Each waste stream has been appraised using the AoS appraisal framework. The appraisals are based on the inventory of radioactive waste presented in Annex I: Appendix A[165]. Appendices C to G in Annex I give the appraisal matrices for each waste stream showing how sustainability has been appraised against the AoS topics for each of the main project phases: construction, operation and decommissioning. The appraisal for each waste stream is presented under the following headings:

- definition of waste type;
- baseline;
- waste management implications of the Nuclear NPS;
- findings of the appraisal for nuclear power station sites;
- considerations for offsite waste management facilities; and
- recommendations.

[157] The Basic Safety Standards of 13th May 1996 are focussed on the new scientific findings in radiological protection contained in the ICRP Publication 60. The member states of the EU are obliged to enact the required national legal and administrative regulations to implement the Euratom basic safety standard by 13th May 2000

[158] The UK's revised Strategy for Radioactive Discharges was published in July 2009. The revised strategy is an update on the 2001-2020 strategy issued in 2002 and demonstrates how the Government will continue to implement the OSPAR Strategy for radioactive substances, UK Strategy for Radioactive Discharges 2006-2030 http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/radioactivity/decc/discharges/strategy/strategy.aspx

[159] Report by the United Kingdom on Intentions for Action at the National Level to Implement the OSPAR Strategy with Regard to Radioactive Substances

[160] http://publications.environment-agency.gov.uk/pdf/GEHO1208BPDD-e-e.pdf

[161] http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf

[162] Wise about Waste: The National Waste Strategy for Wales Part One June 2002

[163] http://publications.environment-agency.gov.uk/pdf/GEHO1208BPDD-e-e.pdf, page 37

[164] http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf, page 29

[165] www.energynpsconsultation.decc.gov.uk

6.4 Spent Fuel

Definition

6.4.1 Spent fuel is defined in regulation as "*nuclear fuel that has been irradiated in and permanently removed from a reactor core; spent fuel may either be considered as a usable resource that can be reprocessed or be destined for final disposal with no further use foreseen and treated as radioactive waste*"[166]. The Government has stated that the building of new nuclear power stations in the UK should proceed on the basis that spent fuel will not be reprocessed and therefore for the purposes of this assessment, spent fuel is treated as waste[167].

Baseline

6.4.2 The baseline UK inventory for spent fuel possibly requiring disposal in a GDF, without the development of any new nuclear power stations, is presented in the MRWS White Paper[168] as 11,200 m3, representing 2.3% of the total volume of legacy waste and 51.6% of the radioactivity[169]. This figure is based on a number of assumptions and is taken as indicative of the existing legacy amounts, but recognising that it may change over time. 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.

Waste management implications of the Nuclear NPS

6.4.3 There is uncertainty around the quantity of spent fuel that might be produced by a new nuclear programme. The volume of spent fuel produced by a single new nuclear power station depends on a number of factors, including the capacity of the plant, its operational lifetime and various other operational considerations (including burn-up).

6.4.4 The 2007 consultation on the future of nuclear power[170] 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 geological disposal facility by around 90%.

6.4.5 More recent work by NDA means it is now possible to update this estimate. NDA has, as part of their disposability assessments under the Generic Design Assessment (GDA) process[171,] which reported its findings to the "Requesting

[166] Atomic Energy and Radioactive Substances, The Trans-frontiers Shipment of Radioactive Waste and Spent Fuel Regulations 2008, Statutory Instruments 2008 No. 3087
[167] Nuclear White Paper page 31
[168] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.decc.gov.uk/mrws, Table 1, page 20
[169] The waste inventory presented in the Managing Radioactive Waste Safely White Paper (DEFRA et al, June 2008) was developed from the 2007 UK Radioactive Waste Inventory and the baseline inventory for high activity wastes present by CoRWM (CoRWM, July 2005) and included the total amounts of radioactive wastes and other materials that could possibly be regarded as waste in the future
[170] BERR (2007) *The Future of Nuclear Power: Consultation document*, page 135. http://www.berr.gov.uk/files/file39197.pdf
[171] 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

Parties"[172], produced estimates for the lifetime spent fuel for the new nuclear power station designs being appraised in the GDA process[173]. 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.

6.4.6 The NDA has estimated that an AP-1000 operating for 60 years would give rise to an estimated 640 disposal canisters[174], 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 0.9 km^2, excluding associated service facilities. This represents approximately 6% of the area required for legacy HLW and spent fuel per EPR reactor, and approximately 55% for the illustrative fleet of nine AP-1000 reactors.

6.4.7 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 EPR reactor, and approximately 50% for the illustrative fleet of six EPR reactors.

6.4.8 The White Paper on Nuclear Power[175] stated that progress towards geological disposal should be coupled with a programme of safe and secure interim storage and that: "*The design of new stores will allow for a period of interim storage of at least 100 years to cover uncertainties associated with the implementation of a geological repository*".

6.4.9 The Government believes that it is technically possible to dispose of new higher-activity radioactive waste in a geological disposal facility and that this would be a viable solution and the right approach for managing waste from any new nuclear power stations. The Government considers that it would be technically possible and desirable to dispose of both new and legacy waste in the same geological disposal facilities and that this should be explored through the MRWS programme. This appraisal has been undertaken on this basis.

6.4.10 The MRWS White Paper[176] stated that "*a robust programme of interim storage must play an integral part in the long-term management strategy and believes this will provide an extendable safe and secure means to hold waste for as long as it takes to identify a site and to construct a geological disposal facility*".

[172] 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

[173] 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 and 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

[174] 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.

[175] Nuclear White Paper page 94

[176] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.decc.gov.uk/mrws page 24

6.4.11 For the purposes of this assessment, final disposal of new nuclear spent fuel is considered to be in a GDF following a period of interim storage at the site of a new nuclear power station. A number of interim storage systems are available, including wet storage, dry storage in vaults and dry storage in casks, and are proven internationally[177]. Wet and dry interim storage, and transport to a GDF has been appraised where appropriate. Conditioning and packaging of the spent fuel for final disposal will either be performed locally at the new nuclear power station or at a central facility that may be at the site of a GDF. It is expected that detailed site specific plans for the spent fuel will be presented by potential operators of new nuclear power stations for assessment by regulators and planning authorities.

6.4.12 New nuclear power stations are designed to extract more energy from the fuel than previous PWR designs (for example Sizewell B) by leaving it in the reactor for increased irradiation, otherwise known as "*burn-up*". As a result of this, the inventory of long lived radionuclides in an individual fuel element increases, although comparatively fewer spent fuel elements will require to be managed. In addition, radioactive decay will cause the fuel to be thermally hot and this has implications for storage durations and a GDF design. Following discharge from the reactor spent fuel has to be cooled. Initially this cooling will be in a water filled pool. After a period of pool storage, operators might then transfer their spent fuel to dry storage casks for the remainder of the period of on-site interim storage.

Findings of the appraisal for nuclear power station sites

6.4.13 The appraisal of Spent Fuel using the AoS framework is shown on the appraisal matrices in Annex I: Appendix C[178] and is summarised on Table 6.2. This appraisal covers the construction, operation and decommissioning of spent fuel management facilities, in particular interim storage facilities at a power station site and for transport of the waste offsite for disposal at a GDF.

6.4.14 Some potential significant negative effects associated with the management of spent fuel have been identified. However, these are considered to be of minor strategic significance (e.g. the effects would be localised) and similar in nature to the effects produced by other aspects of new power station development. Moreover, although the impacts of waste management are generic, the significance of the effect produced, for example on landscape, will depend on local conditions at each site being developed. This uncertainty is reflected in the appraisal matrix (Table 6.2). The potential negative effects which are of minor strategic significance include:

- effects on air quality during construction and decommissioning due to emissions from construction plant and vehicle movements;
- effects on biodiversity and ecosystems during construction directly from land take and indirectly from disturbance, air and water quality changes;
- effects on climate change during construction and decommissioning due to emissions of greenhouse gases from construction plant and vehicle movements;

[177] See page 11 of "The arrangements for the management and disposal of waste from new nuclear power stations: a summary of evidence", which is being published alongside the NPS consultation.
[178] www.energynpsconsultation.decc.gov.uk

- effects on cultural heritage and landscape due to land take and above ground construction;
- effects on soils, geology and land use due to alteration of soil structure and loss of agricultural or Greenfield land, although these latter effects are site-specific; and
- effects on water quality during operation and decommissioning due to risk of flooding of the interim storage facilities, leading to possible deterioration in the conditioned of the stored canisters.

6.4.15 One negative effect, which is considered to be of potentially greater significance, is the effect on flood risk. The effect on flood risk occurs during the operation of spent fuel interim storage facilities, due to the long period over which these facilities might need to be in operation. Because the effect on flood risk arises after the end of operation of the power station, this effect has been allocated to the decommissioning phase, although it may last for longer than the period of decommissioning of the power station.

Table 6.2: Summary of the Significance of Potential Strategic Sustainability Effects: Spent fuel

Sustainable Development Themes:	Significance of potential Strategic effect at each Development stage:		
	Construction	Operation	Decommissioning
Air Quality	-?	0	-?
Biodiversity and Ecosystems	-?	+?	+?
Climate Change	-?	+?	-?
Communities: Population, Employment and Viability	+	+	+
Communities: Supporting Infrastructure	0	0	0
Human Health and Well-Being	0	0	0
Cultural Heritage	-?	-?	-?
Landscape	-?	-?	-?
Soils, Geology and Land Use	-?	-?	-?
Water Quality and Resources	-?	-?	-?
Flood Risk	0	0	-

Key: Significance and Categories of Potential Strategic Effects	
++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
0	Neutral effect
-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/ international significance
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 "?"

6.4.16 It may be possible to mitigate the effects on flood risk through appropriate design, construction and management of flood protection measures. There may also be an option to remove spent fuel from power station sites for interim storage at an offsite facility before it is deposited in a GDF.

6.4.17 Further assessment will be required at the design, development and planning stage where detailed site-specific proposals for spent fuel management will be made for new nuclear power stations.

6.4.18 The interim storage of spent fuel is an established technology and the MRWS White Paper[179] recognises that interim storage will play an integral part in implementing geological disposal. Within the current regulatory framework, each developer is responsible for the design of such facilities at a site level. It is at this local site specific level that a full understanding of the impacts can be identified, minimised and mitigated.

6.4.19 The appraisal has identified a range of measures that might be taken to mitigate the effects of the management of spent fuel and these are reported in Appendix C in Annex I.

Considerations for offsite waste management facilities

6.4.20 In addition to the effects at site level, the revised draft Nuclear NPS will require additional capacity to be provided at a GDF for the spent fuel arising from the new nuclear power stations. Disposing of the spent fuel from a 10GW programme of new nuclear power stations in a GDF would require an underground area that equates to 50-55% of the area that will be required for the disposal of legacy spent fuel and High Level Waste (HLW).

6.4.21 The Generic Design Assessment includes an assessment of the disposability of the higher activity wastes that will be produced by new nuclear power stations. The disposability assessments that have been conducted by the NDA as part of the Generic Design Assessment (GDA) process support this view and have concluded that, compared with legacy wastes and existing spent fuel, no new issues arise that challenge the fundamental disposability of the wastes and spent fuel expected to arise from operation of the reactor designs currently being assessed by the GDA process (EPR and AP-1000). This conclusion is supported by the similarity of the wastes to those expected to arise from the existing pressurised water reactor at Sizewell B. The NDA has concluded that given a disposal site with suitable characteristics, the wastes and spent fuel from the EPR and AP-1000 are expected to be disposable[180].

6.4.22 The extant regulatory framework will ensure that the impacts associated with the design and construction of interim storage facilities and a GDF are minimised and mitigated appropriately. The potential effects of the additional inventories of spent fuel on the collective community well-being of potential GDF host communities will be addressed through the MRWS programme.

Recommendations

6.4.23 The effects of constructing, operating and decommissioning an interim waste storage facility for spent fuel, including the transport of waste from the site, will need to be part of the assessment of the development consent for each new power

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

[180] 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 and 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.

station. The contribution due to the interim storage of spent fuel will also need to be taken into account in the radiological and other assessments for granting a site licence.

6.4.24 The effects of the substantial additional volume of spent fuel due to the Nuclear NPS should be taken into account in the evaluation of a GDF.

6.5 Intermediate Level Waste (ILW)

Definition

6.5.1 ILW is defined as waste "*with radioactive levels exceeding the upper boundaries for low level wastes, but which do not require heating to be taken into account in the design of storage and disposal systems*"[181].

Baseline

6.5.2 The baseline UK inventory for ILW provisionally requiring disposal is presented in the MRWS White Paper[182] as 364,000m^3, representing 76.3% of the total volume of legacy waste (excluding LLW suitable for disposal at LLWR) and approximately 2.5% of the radioactivity[183]. This figure is based on a number of assumptions and is taken as indicative of the existing legacy amounts, but recognising that it may change over time[184].

Waste management implications of the Nuclear NPS

6.5.3 ILW will be generated from general operations and decommissioning of new nuclear stations and may include treatment of radioactive effluents from operations, and metal items such as reactor components following decommissioning. ILW can also arise from the reprocessing of spent fuel but the Nuclear White Paper stated that: "*Our view remains that in the absence of any proposals from industry, new nuclear power stations built in the UK should proceed on the basis that spent fuel will not be reprocessed*"[185]

6.5.4 The NDA has estimated the amount of ILW that would be generated by new nuclear power stations of the AP-1000 type and EPR type being considered in the Generic Design Assessment (GDA). This assessment has indicated that to dispose of the ILW arising from a 10GW programme of new power stations operating for 60 years in a GDF would require an underground area that equates to less than 10% of the area that will be required for the disposal of legacy ILW.

6.5.5 The White Paper on Nuclear Power[186] stated that: "*Having reviewed the arguments and evidence put forward, the Government believes that it is technically possible to dispose of new higher-activity radioactive waste in a geological disposal facility and*

[181] Command 2919 Review of Radioactive Waste Management Policy Final Conclusions July 1995
[182] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.decc.gov.uk/mrws, Table 1, page 20
[183] The waste inventory presented in the MRWS White Paper was developed from the 2007 UK Radioactive Waste Inventory and the baseline inventory for high activity wastes present by CoRWM and included the total amounts of radioactive wastes and other materials that could possibly be regarded as waste in the future
[184] Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal http://www.decc.gov.uk/mrws page 20
[185] Nuclear White Paper page 31
[186] Nuclear White Paper page 27

that this would be a viable solution and the right approach for managing waste from any new nuclear power stations. The Government considers that it would be technically possible and desirable to dispose of both new and legacy waste in the same geological disposal facilities and that this should be explored through the Managing Radioactive Waste Safely programme". Higher-activity wastes include ILW and this appraisal has been undertaken on this basis.

6.5.6 In accepting CoRWM's recommendations in 2006 on legacy wastes, the previous Government[187] stated that progress towards geological disposal should be coupled with a programme of safe and secure interim storage and that: "*The design of new stores will allow for a period of interim storage of at least 100 years to cover uncertainties associated with the implementation of a geological repository*."

6.5.7 Site specific plans for ILW management should fully consider the application of the waste management hierarchy, and BAT[188,189] to minimise local impact.

Findings of the appraisal for nuclear power station sites

6.5.8 The appraisal of ILW using the AoS framework is shown on the appraisal matrices in Annex I: Appendix D and is summarised in Table 6.3. This appraisal covers the construction, operation and decommissioning of facilities, in particular interim storage, for managing ILW at a power station site and for transport of the waste offsite for disposal at a GDF.

6.5.9 Some potential significant negative effects at site level associated with the management and storage of ILW have been identified. However, these are considered to be of only minor significance at a strategic level (e.g. the effects would be localised) and are similar in nature to the effects produced by other aspects of new power station development. Moreover, although the impacts of waste management are generic, the significance of the effect produced, for example on landscape, will depend on local conditions at each site being developed. This uncertainty is reflected in the appraisal matrix (Table 6.3). The negative effects of minor strategic significance identified are similar to those for spent fuel and include:

- effects on air quality during construction and decommissioning due to emissions from construction plant and vehicle movements;
- effects on biodiversity and ecosystems during construction directly from land take and indirectly from disturbance, air and water quality changes;
- effects on climate change during construction and decommissioning due to emissions of greenhouse gases from construction plant and vehicle movements;
- effects on cultural heritage and landscape due to land take and above ground construction;

[187] Response to Report and Recommendations from CoRWM, http://www.defra.gov.uk/environment/radioactivity/waste/pdf/corwm-govresponse.pdf
[188] Environment Agency. Radioactive Substances Regulation Environmental Principles http://publications.environment-agency.gov.uk/pdf/GEHO0709BQSB-e-e.pdf
[189] Environment Agency. Radioactive Substances Regulation: Assessment of Best Available Techniques http://publications.environment-agency.gov.uk/pdf/GEHO0709BQSA-e-e.pdf

- effects on soils, geology and land use due to alteration of soil structure and loss of agricultural or greenfield land, although these latter effects are site-specific; and

- effects on water quality during operation and decommissioning due to the interim storage of waste on site and the risk of flooding of this waste store, leading to possible deterioration of the storage facility.

Table 6.3: Summary of the Significance of Potential Strategic Sustainability Effects: Intermediate Level Waste

Sustainable Development Themes:	Significance of potential Strategic effect at each Development stage:		
	Construction	Operation	Decommissioning
Air Quality	-?	0	-?
Biodiversity and Ecosystems	-?	+?	+?
Climate Change	-?	+?	-?
Communities: Population, Employment and Viability	+	+	+
Communities: Supporting Infrastructure	0	0	0
Human Health and Well-Being	0	0	0
Cultural Heritage	-?	-?	-?
Landscape	-?	-?	-?
Soils, Geology and Land Use	-?	-?	-?
Water Quality and Resources	-?	-?	-?
Flood Risk	0	0	-

Key: Significance and Categories of Potential Strategic Effects	
++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
0	Neutral effect
-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/ international significance
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 "?"

6.5.10 Whilst potential impacts have been identified with the management of ILW arising from new nuclear power stations these will be managed within the planning and legislative framework for new nuclear power stations. The construction of interim storage facilities will have similar impacts to those identified for Spent Fuel and may affect soils, landscape and climate change but this will be a minor component of the

overall nuclear power station development. Site specific assessment will seek to minimise and mitigate impacts.

6.5.11 The appraisal has identified a range of measures that might be taken to mitigate the effects of the management of ILW and these are reported in Appendix D in Annex K. A key mitigation measure is the application of the waste management hierarchy and BAT by developers at the local site level to minimise the impact of ILW.

6.5.12 At this stage of the sustainability assessment process, no significant residual adverse effects associated with ILW have been identified that cannot be managed by developers of new nuclear power stations and through the existing policy frameworks.

Considerations for offsite waste management facilities

6.5.13 The disposal of the additional volumes of ILW from new nuclear power stations to a GDF will have a minor impact on the overall facility size. The size of a GDF is dominated by legacy ILW, HLW and spent fuel (both legacy and from new nuclear power stations).

Recommendations

6.5.14 The effects of constructing, operating and decommissioning an interim waste storage facility for ILW, including the transport of waste from the site, will need to be part of the assessment of the development consent for each new power station. The contribution due to the interim storage of ILW will also need to be taken into account in the radiological and other assessments for granting a site licence.

6.5.15 The effects of the small additional volume of ILW due to the Nuclear NPS should be taken into account in the evaluation of a GDF.

6.6 Low Level Waste

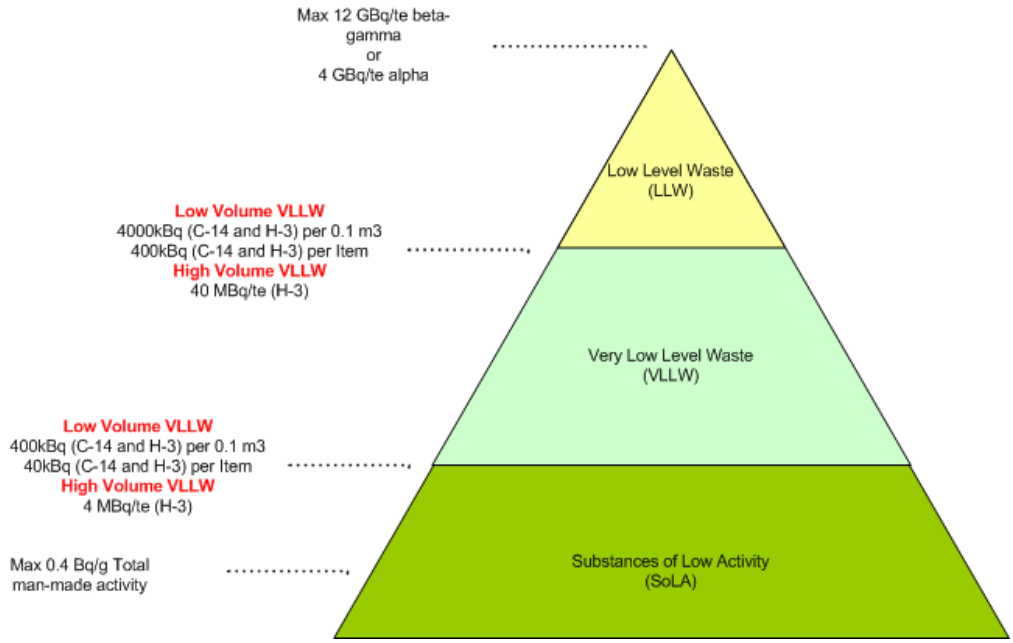
Definition

6.6.1 Low Level Waste is defined as “radioactive waste having a radioactive content not exceeding four gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma activity”[190].

6.6.2 Figure 6.1 provides an indication of the range of the levels of radioactivity within the LLW category.

[190] DEFRA & DTI, Policy for the long term management of solid low level radioactive waste in the United Kingdom, 26 March 2007, http://www.defra.gov.uk/environment/radioactivity/waste/pdf/llw-policystatement070326.pdf

Figure 6.1: Definition of Low Level Waste



6.6.3 This Appraisal of Sustainability considers all activity ranges, where appropriate, within the LLW category and discharges of radioactive material to air, water and soil associated with solid LLW disposal from new nuclear power stations.

Baseline

6.6.4 The UK radioactive waste inventory 2007 estimates that LLW makes up some 90% of the total volume of the UK's existing or committed radioactive waste but contains less than 0.0003% of the total radioactivity[191].

Waste management implications of the Nuclear NPS

6.6.5 LLW is radioactive waste, which poses a comparatively low risk to human health. There are established and proven management routes for the treatment and disposal of LLW. LLW is the largest contributor in terms of volume of waste from the nuclear industry. LLW contains materials such as contaminated soils, protective equipment, building rubble and steel items such as ducting, piping and reinforcement materials. These wastes are produced through the dismantling and demolition of nuclear facilities as well as during routine operations, and will be generated by new nuclear power stations[192].

6.6.6 The Low Level Waste Repository (LLWR) near the village of Drigg in West Cumbria is a key asset in the UK and making best use of this is an essential component of the NDA's draft UK nuclear industry LLW strategy[193]. Disposal will be at the facility currently operating in West Cumbria or a successor facility. This assessment

[191] http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-Consultation-Document-June-2009.pdf, page 14
[192] [192]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, page 6
[193] 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, page 24.

recognises that the LLWR is currently the only national engineered LLW disposal facility in the UK[194] .

6.6.7 LLW arrives at the LLWR in containers of various sizes, either following processing mainly at the WAMAC facility at Sellafield or directly from consigners. Containerised wastes are then grouted and placed into engineered concrete vaults[195].

6.6.8 The NDA has produced a LLW Strategy[196] and LLW Management Plan[197]. The strategy sets out how the NDA will ensure the UK's continued capability and capacity through avoiding generating waste, reusing materials and recycling LLW based on robust information and transparent decision making processes. The strategy is also seeking to promote alternatives to direct disposal at the LLWR. The strategy does this through:

- application of the waste management hierarchy;
- best use of existing facilities; and
- development and use of new fit for purpose disposal routes.

6.6.9 The impact of this strategy will be to reduce the quantities of LLW disposed to the LLWR and similar facilities and the increased availability of alternative waste treatment and disposal routes. For the purposes of this assessment it is anticipated that LLW from new nuclear power stations will be managed in this context and overall arisings minimised.

6.6.10 The Consultation on Funded Decommissioning Programme Guidance included a Base Case to assist with the estimation of the the costs of waste management and decommissioning[198]. In relation to LLW, the Base Case assumes 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*". This is the assumption used in this assessment.

6.6.11 New nuclear power stations are not anticipated to generate LLW during construction, as they are not expected to be built on the site of radioactively contaminated land. This will be dependent upon the land allocated for each new build development. Development on radioactively contaminated land may result in the generation of LLW from remediation activities. If such radioactive waste is generated this would require transport to treatment or disposal facilities in accordance with the UK's National LLW Strategy. This will be subject to site-specific assessment at the new nuclear power station sites.

[194] An application for a proposed LLW facility at Dounreay was granted conditional planning consent on 13 Jan 2009, for use in the decommissioning of Dounreay and Vulcan. For more information see http://www.dounreay.com/waste/radioactive-waste/low-level-waste/new-low-level-waste-facilities

[195] http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-Consultation-Document-June-2009.pdf, page 33

[196] NDA. Draft 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

[197] NDA. UK Nuclear Industry LLW management Plan. http://www.llwrsite.com/UserFiles/File/LowLevelWasteStrategyGroup/UKNuclearIndustryLLWManagementPlan-Rev0-Oct2009.pdf

[198] http://www.berr.gov.uk/files/file44486.pdf, Section 4.1.9

Findings of the appraisal for nuclear power station sites

6.6.12 The appraisal of LLW using the AoS framework is shown on the appraisal matrices in Annex K: Appendix E and is summarised on Table 6.4.

Table 6.4: Summary of the Significance of Potential Strategic Sustainability Effects: Low Level Waste

Sustainable Development Themes:	Significance of potential Strategic effect at each Development stage:		
	Construction	Operation	Decommissioning
Air Quality	-?	-?	-?
Biodiversity and Ecosystems	-	+?	+?
Climate Change	-?	-?	-?
Communities: Population, Employment and Viability	0?	0?	0?
Communities: Supporting Infrastructure	0	0	0
Human Health and Well-Being	0	0	0
Cultural Heritage	0	0	0
Landscape	0	0	0
Soils, Geology and Land Use	0	0	0
Water Quality and Resources	0	0	0
Flood Risk	0	0	0

Key: Significance and Categories of Potential Strategic Effects	
++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
0	Neutral effect
-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/ international significance
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 "?"

6.6.13 The impact of LLW from new nuclear power stations is small in relation to the impact of legacy HLW, ILW and LLW and spent fuel from both legacy and new build.

6.6.14 At this stage of the sustainability assessment process, no significant residual adverse effects associated with LLW have been identified that cannot be managed by developers of new nuclear power stations and through the existing policy frameworks.

Considerations for offsite waste management facilities

6.6.15 LLW for the new build programme is a contributor to the overall capacity requirements at the LLWR. This will have a small impact on LLW disposal capacity management plans, and will impact on the drivers for additional or new LLW disposal facilities over the medium term. This is being addressed by the NDA through their National LLW Strategy programme[199].

6.6.16 The local application by developers of the LLW policy including the waste management hierarchy, BPEO/BPM or BAT[200], to new nuclear power stations and the implementation of waste management innovation will minimise the volumes of LLW disposed of at the LLWR.

Recommendations

6.6.17 The effect of the relatively small additional volume of LLW from new nuclear power stations developed in accordance with the Nuclear NPS should be taken into account in the planning for LLW disposal capacity that the NDA undertake through their National LLW Strategy programme.

6.7 Gaseous and Liquid Radioactive Discharges

Scope of appraisal

6.7.1 Gaseous and liquid radioactive discharges are generated at all stages of the nuclear fuel cycle:

i. Uranium Mining
ii. Uranium Enrichment
iii. Fuel Fabrication
iv. Reactor Operation (including operational solid radioactive waste disposal)
v. ILW /Spent Fuel Storage
vi. Reactor Decommissioning (including decommissioning solid radioactive waste disposal)
vii. ILW/Spent Fuel Disposal

6.7.2 This assessment considers the discharges from stages (iv) to (vii) of the reactor fuel cycle. The Government has stated that the building of new nuclear power stations in the UK should proceed on the basis that spent fuel will not be reprocessed[201] and this assessment has been made on that basis.

Waste management implications of the Nuclear NPS

6.7.3 The radioactivity in gaseous and liquid discharges associated with Reactor Operation (iv) and ILW/Spent Fuel Storage (v) will dominate the discharges associated with the reactor fuel cycle for new build in the UK. They will arise primarily from release of fission and activation products in gaseous (for example halogens, noble gases), particulate (for example metallic fission and activation products) and liquid (from for example tritiated water formed during coolant

[199] http://www.llwrsite.com/UserFiles/File/LowLevelWasteStrategyGroup/LLWStrategy-StrategicReviewSummary.pdf
[200] The EA is proposing to replace BPEO / BPM with Best Available Technique (BAT)
[201] Nuclear White Paper page 31

conditioning and degassing in the case of Light Water Reactors) as well as from fuel movements and other ancillary operations.

6.7.4 The radioactivity in liquid and gaseous discharges associated with Reactor Decommissioning (vi) and ILW/Spent Fuel Disposal (vii)[202] also originate primarily from activation and fission products. Levels of radioactivity are generally lower than in stages (iv) and (v) because of decay of short lived isotopes and loss of volatile species such as iodine, xenon and krypton prior to stages vi and vii commencing.

6.7.5 Gaseous and liquid radioactive discharges may also be associated with LLW management and disposal.

6.7.6 Where this accords with BAT, the discharges in (iv) to (vii) of the nuclear fuel cycle and LLW management and disposal will be filtered and treated and only very small quantities will be permitted to be discharged into the environment in accordance with the permits that must be obtained from the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2010. The treatment of liquid and gaseous wastes means that a majority of the radioactivity is captured and contained as solids (for example in filters, resins etc), and thereby considered in other sections of this assessment.

Findings of the appraisal for nuclear power station sites

6.7.7 The appraisal of gaseous and liquid discharges using the AoS framework is shown on the appraisal matrices in Appendix F and is summarised on Table 6.5.

[202] Considered during emplacement and over the life of the facility including failure of containment (over long periods of time)

Table 6.5: Summary of the Significance of Potential Strategic Sustainability Effects: Gaseous and Liquid Radioactive Discharges

Sustainable Development Themes:	Significance of potential Strategic effect at each Development stage:		
	Construction	Operation	Decommissioning
Air Quality	0	0	0
Biodiversity and Ecosystems	-?	+?	+?
Climate Change	0	0	0
Communities: Population, Employment and Viability	0	0	0
Communities: Supporting Infrastructure	0	0	0
Human Health and Well-Being	-	-	-
Cultural Heritage	-?	-?	0
Landscape	-?	-?	0
Soils, Geology and Land Use	-?	-?	-?
Water Quality and Resources	-?	-?	-?
Flood Risk	0	0	0

Key: Significance and Categories of Potential Strategic Effects	
++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
0	Neutral effect
-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/ international significance
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 "?"

6.7.8 All impacts from gaseous and liquid radioactive discharges can be adequately controlled under existing legislation. At this stage of the sustainability assessment process, no significant residual adverse effects associated with gaseous and liquid radioactive discharges have been identified that cannot be managed by developers

of new nuclear power stations through the existing policy and regulatory frameworks.

Considerations for offsite waste management facilities

6.7.9 The additional quantities of spent fuel, ILW and LLW that might be generated by new nuclear power stations for disposal at a GDF or LLW repository may contribute to additional gaseous and liquid radioactive discharges at these sites. It is expected that the effects of the additional waste from new nuclear power stations on gaseous and liquid radioactive discharges at the waste management facilities can be adequately controlled under existing legislation.

Recommendations

6.7.10 Gaseous and liquid radioactive discharges at nuclear power station sites will be controlled in accordance with permits which must be obtained from the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2010. In considering whether to consent these discharges, the Environment Agency will take into account all radioactive discharges arising from reactor construction, operation and decommissioning including the management of spent fuel and ILW arising from reactor operation.

6.7.11 In considering whether to consent gaseous and liquid radioactive discharges at sites receiving radioactive waste from new nuclear power stations (e.g. GDF or LLW disposal site(s)), the Environment Agency will take account of the additional quantities of radioactive waste arising from new nuclear power stations.

6.8 Non-Radioactive Hazardous Waste

Definition

6.8.1 Hazardous waste is waste with one or more properties that are hazardous to health or to the environment[203].

6.8.2 Categories or generic types of hazardous wastes as well as the properties of hazardous waste are listed in the European Commission's Hazardous Waste Directive[204].

6.8.3 Controls are implemented by the Hazardous Waste Regulations[205] and waste is defined as hazardous on the basis of:

- waste listed as hazardous waste in the list of wastes;
- any other waste stream that the Secretary of State determines as hazardous; or
- a specific batch of waste that the Secretary of State determines to be classified as hazardous.

[203] http://www.defra.gov.uk/environment/waste/special/pdf/hwr-notifguidance.pdf
[204] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0689:EN:HTML
[205] www.opsi.gov.si/si2005/20050894.htm

6.8.4 The EU Waste Framework Directive[206] establishes EU-wide targets for reuse, recycling and recovery of 70% of construction and demolition waste by 2020. This requirement is expected to apply to the construction of new nuclear power stations.

Baseline

6.8.5 Non-radioactive hazardous waste is produced from operating and maintaining both the "conventional" side of the new nuclear power station and the "nuclear island", and this may include waste pond water, laboratory chemicals, and lubricating and fuel oils. Such waste requires management and disposal in accordance with the regulatory framework described in Chapter 3.

6.8.6 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 landfill[207]. The 2007 Nuclear Sector Plan Environmental Performance Report notes that the nuclear sector 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 9% of all hazardous waste is recycled or reused[208]. Therefore the nuclear sector is a minor contributor to the overall UK hazardous waste arisings and whilst the impact of new nuclear powers will be dependent on the number constructed and operated, it is probable that the overall impact will be negligible.

Waste management implications of the Nuclear NPS

6.8.7 The construction, operation and decommissioning of new nuclear power stations will generate non-radioactive hazardous waste. Hazardous waste volumes are anticipated to be minor in the context of current UK arisings and impacts from this waste can be adequately controlled under current legislation, including the application of BAT, and within existing hazardous waste infrastructure and capacity. Uncertainty exists as volumes will be dependent on the number of new nuclear power stations constructed and operated. The nuclear industry currently recycles and reuses a proportion of hazardous waste arisings and the Nuclear Sector Plan establishes an objective to improve recycling rates in the sector[209]. In this context and at this stage of the sustainability assessment process, no significant residual adverse effects associated with non-radioactive hazardous waste have been identified that cannot be managed by developers of new nuclear power stations and through the existing policy and regulatory frameworks.

Findings of the appraisal for nuclear power station sites

6.8.8 The appraisal of non-radioactive hazardous waste using the AoS framework is shown on the appraisal matrices in Appendix F of Annex I and is summarised on Table 6.6.

6.8.9 The construction, operation and decommissioning of new nuclear power stations will generate non-radioactive hazardous waste. These wastes will be similar to those

[206] Detailed within Waste Strategy Annual progress report; http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste-strategy-report-07-08.pdf, page 11
[207] http://www.environment-agency.gov.uk/static/documents/Research/ew_haz_waste_07__2152763.xls
[208] http://publications.environment-agency.gov.uk/pdf/GEHO1208BPDD-e-e.pdf
[209] http://publications.environment-agency.gov.uk/pdf/GEHO1208BPDD-e-e.pdf; Objective 2 minimise and manage solid waste, page 37

generated by non-nuclear industries. It is expected that such arisings will be managed within the current regulatory framework.

Table 6.6: Summary of the Significance of Potential Strategic Sustainability Effects: Non-radioactive Hazardous Waste

Sustainable Development Themes:	Significance of potential Strategic effect at each Development stage:		
	Construction	Operation	Decommissioning
Air Quality	0	0	0
Biodiversity and Ecosystems	0	0	0
Climate Change	0	0	0
Communities: Population, Employment and Viability	0	0	0
Communities: Supporting Infrastructure	0	0	0
Human Health and Well-Being	0	0	0
Cultural Heritage	0	0	0
Landscape	0	0	0
Soils, Geology and Land Use	0	0	0
Water Quality and Resources	0	0	0
Flood Risk	0	0	0

Key: Significance and Categories of Potential Strategic Effects	
++	Development would resolve an existing sustainability problem; effect considered to be of regional/national/international significance
+	No sustainability constraints and development acceptable; effect considered to be of regional/ national/international significance
0	Neutral effect
-	Potential sustainability issues, mitigation and/or negotiation possible; effect considered to be of regional/national/international significance
--	Problematical and improbable because of known sustainability issues; mitigation or negotiation difficult and/or expensive; effect considered to be of regional/national/ international significance
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 "?"

6.8.10 Site waste management plans are now mandatory in England and Wales for construction projects over £300,000. Such plans will be required during the construction and decommissioning phases of new nuclear power stations and will seek to prevent and minimise hazardous waste arisings.

6.8.11 The construction sector is the largest single source of waste arisings and is the largest single contributor towards hazardous waste accounting for 32% of total arisings (1.7 million tonnes)[210]. Whilst the construction and decommissioning of new nuclear power stations will generate hazardous waste, the volumes generated will not be significant in the context of current hazardous waste arisings and therefore, no significant effects are considered to arise from the Nuclear NPS.

Considerations for offsite waste management facilities

6.8.12 The management of the small volumes of non-radioactive hazardous waste arisings from the Nuclear NPS are not expected to raise any significant issues for the facilities that will handle this waste.

Recommendations

6.8.13 The disposal of non-radioactive hazardous waste in accordance with current legislation, including the application of the principle of BAT, should be considered as part of the project level EIA and site permitting processes for new nuclear power stations.

6.9 Summary of findings

6.9.1 The AoS has identified potential effects associated with waste arising from new nuclear power stations. In particular some potential negative effects have been identified associated with the interim storage of spent fuel and ILW at nuclear power station sites. However, these effects are considered to be of minor strategic significance and similar in nature to the effects produced by other aspects of new power station development.

6.9.2 One minor negative effect from the management of spent fuel, which is considered to be of potentially greater significance, is the effect on flood risk. This arises from the possible need to design and maintain flood protection measures for the life of the interim storage of spent fuel which may extend the lifetime of the site beyond what would otherwise be required.

6.9.3 However, there may be an option to remove spent fuel from power station sites for interim storage at an offsite facility before it is deposited in a GDF. If interim storage is provided at power stations, it may be possible to mitigate the effects on flood risk through appropriate design, construction and management of flood protection measures.

6.9.4 New nuclear power stations built in the UK will increase the inventory of spent fuel and ILW for disposal, but the scale of this increase will depend on the number of new nuclear power stations constructed and operated. It is estimated that to dispose of the spent fuel arising from a 10GW programme of new power stations operating for 60 years in a GDF would require an underground area that equates to 50-55% of the area that will be required for the disposal of legacy HLW and spent fuel. Existing plans and programmes are in place to manage the legacy inventory of spent fuel, and new nuclear power stations will need to be accounted for in these plans. It is recognised that some impacts cannot be fully disassociated from the development

[210] See http://www.defra.gov.uk/ENVIRONMENT/waste/strategy/strategy07/pdf/waste07-strategy.pdf and EA (England and Wales) data. This is not directly comparable with 2007 data presented in paragraph 3.153.

and implementation of strategies to address UK legacy radioactive waste, and a new build programme may integrate into these where appropriate. For ILW, it is estimated that to dispose of the ILW arising from a 10GW programme of new power stations operating for 60 years in a GDF would require an underground area that equates to less than 10% of the area that will be required for the disposal of legacy ILW.

6.9.5 The UK Nuclear Industry LLW Strategy[211] should have a positive influence by reducing legacy waste volumes, and also in facilitating the management of predicted LLW arising from the new nuclear power stations.

6.9.6 The appraisal also notes that the impacts associated with interim storage facilities for ILW and spent fuel and impacts associated with a GDF will be fully assessed as part of project level EIAs once site specific designs and proposals are developed.

[211] UK Nuclear Industry LLW Strategy http://www.nda.gov.uk/loader.cfm?csModule=security/getfile&pageid=29908

Chapter 7. Key findings of the AoS of the revised draft Nuclear NPS with potentially suitable sites

7.1 Introduction

Context

7.1.1 This chapter sets out a summary of the findings of the revised Appraisal of Sustainability of the revised draft Nuclear NPS. As described earlier in Chapter 2, the AoS framework of sustainability objectives was the basis for appraising the sites that were found satisfactory with regard to the exclusionary criteria in the SSA process. The detailed findings of the appraisals for those sites that were considered potentially suitable by the SSA process are set out individually in each of the AoS site reports. Summaries of the key findings of the AoS for each site are set out later in this Chapter 7. Following the public consultation which took place between November 2009 and February 2010, the Government concluded that the sites at Braystones and Kirksanton are not potentially suitable and that the site at Dungeness remains unsuitable. Therefore, this revised AoS has appraised the revised draft Nuclear NPS with eight potentially suitable sites for new nuclear power stations.

7.1.2 The revised draft Nuclear NPS has the potential to have positive and negative effects on communities and the environment. Some of these potential effects[212] are common to all new nuclear power stations, for example, the generation of low carbon electricity. The significance of such effects and the possibilities for mitigating any potentially adverse effects depends upon the number of new nuclear power stations built.

7.1.3 Similarly, potential effects associated with the requirement for water for cooling are common to all new nuclear power stations. However, the significance of such effects and the possibilities for mitigating any adverse effects depends upon the detailed design together with the characteristics and sensitivities of the local communities and environment where the new stations are proposed to be built. This will be examined as part of the detailed studies carried out for project level EIAs that will be required to accompany applications to the IPC for development consent for new nuclear power stations.

Significance of Effects

7.1.4 The individual AoSs of the potentially suitable sites listed in the revised draft NPS examined likely significant effects that were of national or international importance, for example, internationally protected nature conservation sites, and objectives for good chemical and ecological water quality under the Water Framework Directive[213]

[212] In this AoS, adverse and negative are used interchangeably to describe effects; similarly for beneficial and positive effects
[213] Water Framework Directive (2000/60/EC)

and other relevant European Directives. The individual site AoSs also considered potential likely significant effects that are of more local or regional importance, for example, a County Wildlife Site or regional/sub-regional objectives for regeneration and economic development. Thus the site level AoSs recognised two categories of significance of effects:

- **Strategic** (regional, national and international importance) – likely significant effects are described and mitigation possibilities suggested for any significant adverse effects (presented in section 6 of each site AoS Report)

- **Local** – details are available to inform the IPC and others of issues that are likely to arise at the next stage of planning and assessment processes (discussed in section 5 of each revised site AoS Report)

7.1.5 Strategically significant effects of the sites were taken into account in considering the interactions between topics and the potential cumulative effects of the revised draft Nuclear NPS at the national level. Locally significant effects of the sites were taken into account in considering the interactions between topics and the potential cumulative effects of the sites locally, sub-regionally and regionally.

Inter-relationships of Effects

7.1.6 Many of the topics for sustainable development that are relevant to the appraisal of the revised draft Nuclear NPS are inter-related, particularly between biodiversity, climate change, water, human health and well-being, and communities - their viability (employment and population) and their supporting infrastructure including basic services. Each topic was appraised separately and the detailed findings of these appraisals are provided in Appendix 1[214] to this AoS report. Summaries of the findings are set out in the sections following in this Chapter 7. The key inter-relationships between topics are discussed where most relevant in each topic and the overall findings are also summarised in a section at the end of this Chapter 7.

Levels of Analysis

7.1.7 Thus the findings of the AoS reflect analysis at different levels as follows:

- the likely significant cumulative effects of building a number of new nuclear power stations, i.e. generally at the national level and by sustainability topic;

- the likely strategically significant effects of each site and their cumulative effects by sustainability topic at the regional or sub-regional level; and

- the likely strategic and locally significant effects for each site with their inter-relationships and cumulative effects.

[214] DECC (2010) *Appraisal of Sustainability of the revised draft Nuclear NPS: Appendix 1 & 2 to the Main Report*, www.energynpsconsultation.decc.gov.uk

Consultation

7.1.8 During the preparation of the revised draft NPS, the AoS was subject to ongoing liaison with the statutory consultees[215] and other Government departments.

Presentation of Findings

7.1.9 **By Topic:** Radioactive and hazardous waste is considered separately and the findings of the appraisal are summarised in Chapter 6. For each detailed sustainability topic in the Appendices A1-A11, the findings of the revised AoS are presented according to the following approach which reflects the requirements of the SEA Directive:

- an introduction setting out the definitions and characteristics of the topic
- a policy context with the key sustainability objectives that are relevant to the appraisal
- the scope of the appraisal
- the current situation and the likely evolution without the revised draft Nuclear NPS
- the likely effects of the revised draft Nuclear NPS nationally and by each site
- a summary and recommendations for the revised draft NPS

7.1.10 **By site:** For each detailed site report presented in the Annexes A-H[216], the findings of the AoS are presented according to the approach below in order to reflect the requirements of the SEA Directive:

- an introduction explaining the AoS and revised draft Nuclear NPS so that each report may be read separately
- a description of the nominated site proposals
- a policy context at the regional and any relevant sub-regional levels
- a characterisation of the site and surrounding area including the current baseline situation and likely evolution of the area without the proposals
- the likely effects of each site proposal including possibilities for mitigating any potentially significant adverse effects
- a summary including any key issues that were recommended for the revised draft NPS to reflect as particular considerations for the IPC to take into account when determining individual planning applications for new nuclear power stations

[215] Environment Agency, English Heritage, Natural England, the Department of the Environment (Northern Ireland), Historic Scotland, Scottish Natural Heritage, the Scottish Environment Protection Agency, Cadw, Environment Agency Wales, Countryside Council for Wales, Department of Health, Health Protection Agency and Nuclear Installations Inspectorate were consulted in the development of this AoS.

[216] See www.energynpsconsultation.decc.gov.uk

7.1.11 **AoS Recommendations:** The AoS was carried out in an iterative and ongoing way with the NPS process so that the findings could inform the development of the revised draft NPS. This was particularly with regard to identifying any significant adverse effects and possibilities for mitigation that could inform the revised draft NPS and its guidance on impacts for the IPC when considering applications for development consent. The key recommendations from the AoS findings and the key resultant changes to the revised draft NPS are set out in Appendix 2. Where possible, the Government incorporated recommendations from the AoS and comments from the statutory consultees. In this chapter, the key recommendations are summarised at the end of each topic section and appear in italics.

Structure of this Chapter

7.1.12 Therefore, this chapter summarises the revised AoS findings by topic and by site; it is structured as follows:

- summary of findings by sustainable development topic (details set out in Appendices A1 to A11)
- key interactions and cumulative effects between topics
- summary of generic findings for the eight sites (details set out in Annexes A-H)
- summary of key findings specific to each potentially suitable site
- an overall summary of revised AoS findings

7.2 Summaries by Sustainable Development Topic

Climate Change - Mitigation

7.2.1 The operation of nuclear power stations is a low carbon energy source and associated with lower greenhouse gas (GHG) emissions when compared to fossil fuel facilities. The AoS identified that there are likely to be positive effects on this sustainability objective and the significance of these effects will increase with the number of nuclear power stations in operation. Climate change adaptation is cross-cutting and covered where relevant within the following sections on biodiversity and flood risk.

7.2.2 The AoS noted that the UKCIP scenarios only look out until 2100 and that for nuclear power stations having a longer site life of approximately 160 years, the project level assessment would need to use data sources such as the IPCC Assessment Reports and updated reports/scenarios as necessary. The AoS also noted that minor levels of GHG emissions may arise from the transport of goods and workers, particularly during the construction phase; the significance of this depends upon the relative sustainability of local/regional transport services.

7.2.3 *The AoS suggested that the revised draft NPS could advise the IPC that nuclear power generation is associated with relatively low levels of GHG emissions, particularly when compared with conventional fossil fuel generation. The revised AoS identified overall that there are likely to be significant positive effects that will contribute to meeting the UK climate change commitments.*

Biodiversity and Ecosystems

7.2.4 The revised draft Nuclear NPS was also subject to HRA and the details of the findings are presented in a separate revised Main HRA Report and individual site HRA reports. The Main HRA Report also sets out the Government's consideration of alternative solutions and the Imperative Reasons of Overriding Public Interest for why the plan should proceed given the findings presented. The HRA recommended that further project level HRAs should be required and the revised draft Nuclear NPS requires that for new nuclear power stations any development consent will be required to be supported by a detailed HRA at the project level, including Appropriate Assessment where necessary. The findings of these assessments have been incorporated into the revised AoS reports.

7.2.5 A number of common implications for biodiversity of international, national and local importance were identified including potential adverse effects from water discharge, abstraction and quality; habitat and species loss and fragmentation; coastal squeeze; disturbance events (noise and visual); and air quality. These are most likely to be significant during the construction and operational stages of the power stations, and could also be significant during decommissioning.

7.2.6 There is the possibility of mitigating certain potential adverse effects on biodiversity, for example through project design to avoid sensitive areas; Environmental Management Plans to avoid or minimise disturbance to wildlife, and minimise risks of pollution; and habitat retention and species protection measures on site. The significance of impacts and the potential effectiveness of mitigation proposals can only be determined with detailed baseline studies to inform further ecological studies at each site as part of the project level EIAs that will be carried out as part of the applications to the IPC for development consent.

7.2.7 At a national level, potential negative cumulative effects were identified for the internationally protected shingle habitat '*perennial vegetation of stony banks*'[217], which occurs within a number of European sites in close proximity to the nominated sites at Heysham, Sizewell and Wylfa.

7.2.8 The development of more than one potentially suitable site could result in cumulative effects on certain species including:

- important assemblages of breeding, over-wintering and passage birds such as breeding little tern (at five sites) and over-wintering redshank (at three sites);
- fish species (such as Atlantic salmon and sea and river lamprey); and
- other species of European importance (such as otters).

It was recommended by the revised AoS that detailed baseline studies into the nationally and internationally important species that may be affected will need to be undertaken by developers to inform assessments of the cumulative ecological effects at the project level, and taken into account by the IPC in decision-making.

[217] Listed as habitat feature 1220 in Annex 1 of European Habitats Directive

7.2.9 Potentially significant negative cumulative effects for biodiversity were identified in the south west of England, as a number of European sites are likely to be affected by more than one new nuclear power station. At the local level and for all sites, potential cumulative effects have been identified with other plans and projects, especially with other energy proposals including tidal, wave, biomass, and wind farm projects. Proposed projects including Britain's Energy Coast Masterplan (in the north west of England and some of the options for a Severn Tidal Power project (in the south west of England), are considered particularly significant for biodiversity in conjunction with proposed new nuclear development in these areas.

7.2.10 Mitigation measures are recommended within the revised site HRA and AoS reports and it is considered that these may help address the potential adverse effects identified on European and nationally designated sites and local biodiversity, if the measures are implemented effectively. At this strategic level, uncertainties remain as to whether mitigation will be wholly effective, and that only at the project level of assessment (e.g. project level EIA and HRA to support applications to the IPC for development consent) can a conclusion of no adverse effect on the integrity of European sites and associated biodiversity be made with confidence. Overall, it is concluded that, at this stage, it is considered likely that there will be strategically significant and adverse effects on biodiversity at the international, national and local levels, but that the significance of such effects can only be confirmed through assessments undertaken at the project level.

7.2.11 *The AoS recommended that the revised draft NPS should advise the IPC that the significance of biodiversity effects can only be determined through project level studies and guide the IPC to the findings of the site level AoSs and site HRAs to help scope the studies needed for the project level EIAs and HRAs. The AoS recommended that the NPS should draw attention to the IPC of potential cumulative effects of new nuclear sites in the north west and south west of England with other potential developments.*

7.2.12 *Overall the revised AoS found that there are likely to be significant adverse effects on national and European sites of biodiversity value and that the effectiveness of mitigation possibilities is uncertain and needs to be evaluated at the project level assessments. The revised AoS also found that there are likely to be significant adverse effects on the wider biodiversity at the local level and that these need to be evaluated during the project level EIAs. The revised AoS identified overall that the there are likely to be significant adverse effects on biodiversity of local and European importance.*

Communities: Population, Employment and Viability - Supporting Infrastructure

7.2.13 The sustainability and viability of communities is associated with a number of inter-related factors including a flourishing and diverse economy, good transport, and good services. The relevance of these factors for the revised draft Nuclear NPS depends upon the scale and locational characteristics of the proposed new power stations.

7.2.14 There are likely to be positive effects for employment locally and associated economic benefit through the use of supporting services, particularly during the construction phase and this could be of regional significance. During the operational phase and in the longer term, the effects of the revised draft NPS are likely to

contribute significantly to the development of jobs nationally in the nuclear and associated industries, including enhancement of training and skills, and provision of goods and services to the nuclear industry.

7.2.15 As with any large scale construction project, there is the potential for short term negative effects during construction if a number of sites were developed at the same time. This could result in a shortage of construction workers, local communities being disturbed by an incoming workforce and additional pressures placed on local services. However, there are possibilities for mitigating such effects depending upon local circumstances and needs.

7.2.16 Similarly, there are likely to be negative effects on transport at the local level and on regional or national networks which are under stress. The significance depends upon the location and for some areas there will be opportunities to mitigate impacts during the construction and decommissioning phases by using rail and/or maritime freight. The AoS suggested that the revised draft NPS could advise the IPC that there may be adverse effects on regional transport networks. However, this is an effect which is generic to all significant energy infrastructure. EN-1includes references to Transport Assessments.

7.2.17 Non-radioactive wastes may place a demand on local facilities. This is unlikely to be significant with effective implementation of operational waste management plans. There may be potential for minor positive effects locally through generation of secondary aggregates during demolition at sites where existing facilities are being decommissioned. Potentially negative cumulative effects may result from waste disposal from the cluster of sites in the south west of England.

7.2.18 The opportunities for upskilling, education and supporting industries are likely to be more significant if there were a cluster of new nuclear power stations, with some benefits possible for the south west and the north west of England. The effects of the revised draft Nuclear NPS in combination with other renewable energy projects is likely to contribute positively to objectives for regional economic development.

7.2.19 *The AoS recommends that the revised draft Nuclear NPS should advise the IPC of the potential enhancement for positive economic development effects, and that cumulative positive effects are likely to be more significant regionally where there are clusters of potentially suitable sites . Overall the revised AoS found that there are likely to be significant beneficial effects on employment and viability for communities.*

Health and Well-Being

7.2.20 Health is wider than just absence of disease and our health can be affected by a complex interaction between various factors, such as our personal behaviour and lifestyles, our living and working conditions, the condition of our communities, and our access to health and other services. The AoS identified the generic implications for health and well-being from new nuclear power stations including:

- radiation from planned release of discharges, and unplanned releases of radioactive waste;
- safety and security;

- employment;
- emissions to water and air;
- noise; and
- accessibility to green space and exercise.

7.2.21 The health factors that are relevant and their implications for the revised draft Nuclear NPS depend upon the type, scale (both the size/output of the individual power stations and the overall number of stations built), detailed design, and locational characteristics of the proposed developments. Radiological effects (from planned releases and accidental releases), security and safety, together with the long term characteristics of nuclear projects that include the provision for radioactive waste (see Chapter 6), are particular technology specific issues for health and well-being.

7.2.22 Radioactivity occurs naturally and radon gas is the major source of radiation exposure to the general population in the UK and many other countries[218]. The nuclear industry is regulated in the UK through a strict framework[219] to minimise potential health effects to workers and the general public by ensuring that radiation doses are well within internationally agreed limits. This also includes an emergency preparedness framework in the event of an accidental release of radiation into the environment.

7.2.23 The predicted effects of the revised draft NPS on radiological health issues are likely to be neutral since the strict regulatory mechanisms will provide the same level of protection to health as exists at present. The revised draft Nuclear NPS sets out that the existing regulatory systems for operation of nuclear power stations will continue to apply to new nuclear power stations so that potential effects associated with safety, security, and radiation doses to the public and workers will be dealt with through the current nuclear licensing and health protection systems. The AoS recommended that the revised draft NPS should consider suggesting that the IPC and regulatory authorities pay particular consideration to clusters of new nuclear power stations, with regard to possible cumulative effects of routine discharges. In doing so they should take into account that the law which limits radiation to which members of the public are exposed from all sources[220] of 1 mSv per year, applies to the cumulative effects of planned exposures. Therefore the radiation to which people living near to a new nuclear power station are exposed would have to be less than 1 mSv per year, taking into account exposures from any other nearby sites and any past controlled releases. Public perceptions of health risks may be mitigated by continued engagement during the ongoing assessment processes.

7.2.24 There are significant health benefits to be realised from having a reliable and secure supply of energy. Interruptions to supply could have an adverse effect on health if critical infrastructure, such as hospitals or water treatment plans, are affected. Indirect negative effects on health and well-being of not having a secure energy

[218] http://www.whi.org.uk/
[219] Ionising Radiations Regulations 1999, Environmental Permitting (England and Wales) Regulations 2010 and Nuclear Installations Act 1965
[220] Excluding medical exposures of patients and natural background radiation

supply are likely from the possible closure of businesses, reduced employment, strain on services and potential loss of viability of communities.

7.2.25 Significant positive health and well-being effects associated with increased long term employment and enhanced community prosperity were identified for each potentially suitable site. Generally this is significant at the local or sub-regional level.

7.2.26 The positive indirect effects on health and well-being from securing long term employment and community viability, often in rural areas, are likely to be more significant in the north west and south west of England where there is the potential for more than one new nuclear power station in the region and opportunities for developing wider expertise and supporting services to the nuclear industry.

7.2.27 The potential for loss of recreational land and access is likely to be significant at the local levels for most of the sites and will be considered during the project level EIAs. The AoS identified that there are health benefits to be realised from having a reliable and secure supply of energy and that there are indirect positive health effects associated with enhanced prosperity and long-term employment opportunities. Any indirect effects on supporting services, associated infrastructure, and health inequalities are not significant at the national scale and will be addressed during the project level assessments; this includes the negative local effects from noise and disturbance associated with the construction of many major infrastructure projects. Nuclear power stations are often located in rural areas on the coast with potential conflicts for recreation and amenity.

7.2.28 *The AoS recommended that the revised draft NPS should guide the IPC to consider requesting a sustainability statement / assessment for each application to ensure full consideration is given to sustainable communities and interactions between a range of sustainability issues, including the wider determinants of health. The NPS should highlight to the IPC that there may be beneficial effects for health and well-being from secure long term employment and community viability arising from new nuclear power stations. The AoS also recommended that the revised draft NPS should advise the IPC that nuclear power stations are often located in rural areas on the coast with potential conflicts for recreation and amenity (and their subsequent impacts on health and well-being). Overall the revised AoS found that there are likely to be health benefits from having a reliable and secure supply of energy.*

Cultural Heritage

7.2.29 Effects within the footprints of the sites are associated with the disturbance or loss of any cultural heritage features present as a result of ground works and excavations. Mitigation measures are the minimisation of the footprints and the avoidance of disturbance to features, where possible, during the planning and design stage. This is informed by detailed investigations during the project level EIA stage and watching briefs during excavations and ground works.

7.2.30 Effects outside the footprints of the sites are due to impacts on the settings of nearby cultural heritage features within a landscape context. These impacts are highly dependent on distance and effects of scale can result in a reduced amenity value for that feature. Mitigation may be very difficult or impossible to achieve. Disturbance effects may also impact on the amenity and setting of cultural heritage features outside the footprint of the nominated site, particularly during the

construction phase, but can be controlled and minimised through good environmental site practices.

7.2.31 The predicted effects of the revised draft Nuclear NPS on cultural heritage are likely to be negative throughout all phases of development and are associated with the location and scale of development at the sites. The significance of these effects will depend on the importance of the cultural heritage features, their location within the site or their setting relative to the site. Effects are likely to be felt at a local or regional scale, depending on distances, sight-lines, topography and the ability to mitigate. For one site, Bradwell, there are considered to be major negative effects due to the negative effects on the settings of nearby nationally scheduled monuments and listed buildings. However, mitigation could be applied by siting the proposed facility close to the existing power station on the western side of the site.

7.2.32 Cumulative effects of local or regional significance may arise where sites are in close proximity to each other or are in combination with other major development and infrastructure projects, potentially affecting the same cultural heritage features.

7.2.33 *The AoS recommended that the revised draft NPS should advise the IPC that significant negative effects to cultural heritage resources may be difficult to mitigate. Overall the revised AoS found that there are likely to be minor significant negative effects on cultural resources except for the Bradwell site where the effect may be more significant. The significance and effectiveness of mitigation possibilities is uncertain and needs to be evaluated at project EIA level.*

Landscape

7.2.34 The potentially suitable sites, whilst being distinct in their local settings and planning context, share the following landscape issues:

- the sites are generally in less populated areas that may have value for visual amenity and as landscape resources;
- nuclear power stations usually require coastal/shoreline sites (for cooling water) and the scale of the facilities means that the scope for visual mitigation is quite limited; and
- the long operational timescale involved leads to some uncertainty over future land uses on decommissioned sites.

7.2.35 There is the potential for long term irreversible effects on landscape through the location of reactors and plant at all the sites. These effects are increased if visually-intrusive cooling towers are required. However, with the exception of Oldbury, cooling towers are not the preferred option proposed by the nominators. EN-1 states that the IPC should be satisfied that the application of modern hybrid cooling technology or other technologies are not reasonably practicable before giving consent to a development with natural draught cooling towers. This is because hybrid cooling systems (such as mechanical draught) do not exhibit visible steam plumes except in exceptional adverse weather conditions and use shorter cooling towers. These factors would mean less of a visual impact.

7.2.36 At all sites there is potential for short-term effects on landscape due to construction including visual impact of construction plant and equipment, disturbance of

landforms, and removal of vegetation. In addition, increased traffic during construction and operation may have negative effects on landscape qualities, including noise and dust pollution affecting tranquillity.

7.2.37 Changes to site layout and boundaries can be made to minimise some direct landscape effects. Buffer zones and protection fences can be utilised to avoid or reduce effects on significant nominated site landscape features. Reinstatement or restoration of original landforms and vegetation where possible can help to minimise the impact of construction on landscape. In visual terms, many of the proposed power station sites will be seen in the context of existing power stations. However, there are still likely to be some long-term negative visual effects with limited potential for mitigation, until decommissioning.

7.2.38 The landscape effects of the revised draft Nuclear NPS may act in combination with the impacts of other planned energy projects: including wind farms and tidal energy. In combination effects are likely to include: improvements to transmission grid connectivity and possibly also nearby local housing and road infrastructure developments.

7.2.39 The AoS identified that the revised draft Nuclear NPS is likely to have negative effects locally at all sites. At Sizewell, negative effects of strategic significance were identified as the site is wholly within an AONB. Landscape effects at Sellafield were also considered of national significance[221] due to the proximity of the Lake District National Park.

7.2.40 There are likely to be some landscape and visual impacts that cannot be effectively mitigated at all sites due to the scale of development that is proposed. The revised AoS recommended that the revised draft NPS should consider drawing these particular cumulative effects to the attention of the IPC when determining individual planning applications and examining the capacity of this particular area to accommodate such change.

7.2.41 *The AoS recommended that the revised draft NPS should advise the IPC that there are likely to be some visual impacts that cannot be mitigated due to the scale of new nuclear power stations; the significance of this is increased if cooling towers are proposed. The significance and effectiveness of mitigation possibilities is uncertain and needs to be evaluated at project EIA level. Overall the revised AoS found that there may be neutral or minor negative effects on landscape except for the sites at Sizewell and Sellafield where effects may be of national significance.*

Air Quality

7.2.42 The factors affecting air quality that are relevant for the revised draft Nuclear NPS depend on the type, scale, detailed design, locational characteristics and to a limited extent ancillary activities of the proposed new nuclear power stations. As well as these site specific issues, there are certain common implications for air quality arising from a NPS as follows:

- emissions to air of non-radioactive air quality pollutants/greenhouse gases; and

[221] The national significance arises because National Parks are a national designation, not because a new nuclear power station at Sellafield would be visible across the country.

- possibility of national and transboundary effects, in the event of a significant unintended release of radioactive emissions.

7.2.43 Due, principally, to the relatively low level of air pollutant emissions from nuclear power stations overall air quality in the UK is likely to improve as a result of constructing nuclear power stations instead of oil, coal and gas fired power stations.

7.2.44 In areas local to the proposed nuclear power stations, air quality (in respect of dust during construction and traffic pollutants) would be expected to worsen as a result of emissions from construction and workforce vehicles. However, it would be possible to mitigate such effects through measures such as damping down the construction site regularly, selection of cleaner fuels, highway improvements, use of rail and sea transport and the adoption of sustainable traffic and travel management plans.

7.2.45 There is a risk of deterioration in air quality due to radioactive releases to air or accidental releases of radioactive emissions. However, the risk of such an accident is judged to be very small because of the strict regulatory regime in place in the UK. Radioactive discharges will also need to be within authorised limits. Therefore significant transboundary effects are not considered likely.

7.2.46 *The revised AoS recommended that the revised draft NPS could highlight to the IPC that effects on air quality are unlikely to be significant but that effects associated with the construction phase should be considered in the scope of the project level EIAs.*

Soils, Geology and Land Use

7.2.47 Geology and its associated soils influence the use of the land and the characteristics of the communities that live and work on the land. Soils and geology greatly influence vegetation and water with effects also linked to landscape, biodiversity, cultural heritage and material assets. Some geological formations and soils are also important as mineral resources, for earth science, archaeology, and ecology.

7.2.48 The factors affecting soils and geology that are relevant for the Nuclear NPS depend on the type, scale, detailed design and locational characteristics of the proposed new nuclear power stations. In common with other major infrastructure projects, nuclear power stations have the potential to have effects on soils and this depends upon the characteristics and sensitivities to change of the receiving environment and communities. Ground conditions and their suitability for development are mainly determined by geological and soil conditions. This is a particular feature that is relevant for the revised draft Nuclear NPS and common implications for soils, geology and land use are as follows:

- Sites are adjacent to existing nuclear power station sites[222];
- sites are often located on coasts resulting in coastal squeeze, loss of intertidal land use and associated habitats;

[222] Or nuclear facilities in the case of Sellafield

- sites are often located on marine shorelines and estuaries which may affect coastal geomorphological processes including erosion / deposition and sediment transport processes;
- new power station and associated infrastructure development will affect existing land uses, particularly agricultural land use;
- new development may result in loss of soil and mineral resources including sand and gravel deposits or other minerals;
- the development, operation and decommissioning of nuclear power sites may result in the increased risk of pollution and potential contamination of soils and controlled waters;
- problems associated with land restoration, including reinstatement of previous soil conditions, loss of organic matter, erosion, changes to nutrient status, pH, and homogenisation; and
- development may result in soil loss or burial, physical damage including compaction and structural damage, changes to soil water regime, effects on soil biota and soil stripping and storage.

7.2.49 A number of potentially negative sustainability issues have been identified relating to effects on soils, geology and land use. These tend to be site specific in character. It is important to note that effects on soils also may directly affect the soil water regime which in turn may affect various terrestrial habitats. It is recognised that the development of the sites may result in the increased risk of pollution and potential contamination of soils and controlled waters on a local scale.

7.2.50 *The revised AoS recommended that the revised draft NPS should inform the IPC that effects on soils may affect the soil water regime which may affect various terrestrial habitats and this will need to be considered in the project level EIAs and HRAs. Overall, the effects of the revised draft Nuclear NPS are considered to be neutral on soils and geology.*

Water Quality and Resources

7.2.51 The factors affecting water that are relevant for the revised draft Nuclear NPS depend on the type, scale, detailed design and locational characteristics of the proposed new nuclear power stations. There are certain common implications for water quality and resources from the revised draft Nuclear NPS which have been identified as follows:

- influences from cooling water abstraction and discharge;
- effects on capacity to meet future water demand;
- effects on local groundwater bodies;
- effects on coastal process, including sediment movement, due to coastal works such as construction of flood defences; and

- indirect effects on the marine environment and fisheries may result from changes to water quality or coastal processes and these are addressed in the sections on biodiversity and ecosystems.

7.2.52 The site AoSs identified that, generally, there are likely to be minor negative effects on water quality and resources. Such adverse effects may compromise the achievement of water quality objectives, for example, the requirements of the Water Framework Directive[223] (WFD) to maintain or achieve good status. Minor adverse effects are likely on water quality in water bodies where cooling water is to be abstracted and discharged. However, the effects of these abstractions and discharges are generally capable of mitigation through appropriate siting, design, and operation, and will also be subject to Environment Agency consenting processes, although the outcome of these processes cannot be prejudged. Effects may be more difficult to mitigate in restricted estuarial waters than in coastal waters.

7.2.53 A further minor negative effect will be the effect of increased water demand on the capacity to meet water demand at a regional scale. This may be a more significant issue during the construction phase at each site. Individual water companies will have plans in place for meeting future demand and may be able to incorporate further demand from large industrial clients if informed at an early stage. Abstractions will be subject to licensing restrictions.

7.2.54 There may be minor negative effects on local groundwater bodies, where effects may be further increased if cooling water is to be taken from non-seawater sources. Studies should be carried out to determine the effect on groundwater and surface water systems. It will be important during the project level EIAs to investigate any effects that might compromise WFD objectives.

7.2.55 Cumulative effects are likely to occur where there are clusters of sites. At these locations there will be additional stresses on water supply and may be effects where sites discharge cooling waters to the same water body. Cumulative effects may be most significant in the south west of England and the Severn Estuary. Mitigation options should be investigated to ensure cumulative effects are dealt with.

7.2.56 *The revised AoS recommended that the revised draft NPS should highlight to the IPC the characteristics of cooling water for new nuclear power stations and the implications for the marine and estuarial environments, including the interactions between discharges from regional clusters of nominated sites. The NPS should also inform the IPC that there could be increased water demand, particularly during the construction phase, which would be of greatest significance in those regions that are already under water stress. Generally, the revised AoS identified that minor negative effects are likely to be mitigated and overall the effects on water quality and resources are likely to be neutral.*

Flood Risk

7.2.57 The beneficial effect of power generation from nuclear power stations with regard to climate change mitigation is noted earlier under the climate change topic. As a low carbon source, nuclear power stations are expected to make a positive contribution

[223] River Basin Management Plans are the plans for protecting and improving the water environment in accordance with the requirements of WFD. They have been developed by the Environment Agency in consultation with organisations and individuals. http://www.environment-agency.gov.uk/research/planning/33106.aspx

to achieving carbon reduction targets which, indirectly, should have a beneficial effect on flood risk through moderating changes in rainfall patterns and sea level rise. Climate change adaptation is primarily considered in this section with regard to flood risk management.

7.2.58 In other respects, the relationship between the revised draft Nuclear NPS and flood risk is essentially local or possibly sub-regional where a number of potentially suitable sites are in proximity to each other. It also has a number of different effects. The first of these is the local impact that the individual development may have on the risk of flooding to land adjacent to those sites. Secondly, the sites themselves may be vulnerable to the risk of flooding from a number of causes, coastal, storm surge, fluvial, groundwater and pluvial. Finally, flood risk management measures put in place to mitigate the impacts of flooding on or from individual sites may impact on coastal process, hydrodynamics and sediment transport, which in turn may impact on designated habitats. All of these flood risk effects can occur during the construction, operation or decommissioning phases. As a result flood risk assessments need to take a long term view.

7.2.59 The flood risk effects to areas surrounding development sites could be either negative or positive. Negative impacts could be that flood risk is increased to the surrounding area as a result of any land raising required to protect the power stations or the footprint and layout of the sites which could impact upon floodplain storage and flood flow pathways. Positive impacts could also arise, as flood risk mitigation measures constructed as a result of the power stations could also provide flood risk protection for new and existing developments in the district. Similar negative and positive impacts could affect designated landscapes, for example, sensitive habitats could become more vulnerable to flooding, or as a result of improved defences – less vulnerable.

7.2.60 Climate change will increase flood risk from all causes. Coastal flood risk is likely to increase as a result of predicted increases in sea level and changes in storm surge. Changes to the seasonal distribution of rainfall and in the intensity of extreme rainfall events are also likely to increase flood risk. Climate change is also likely to result in changes to coastal erosion.

7.2.61 The mitigation measures that may be required to manage flood risk as a result of the revised draft Nuclear NPS could have potentially negative effects on coastal processes and hydrodynamics. These measures have the potential to have secondary impacts on biodiversity and water quality, therefore potentially hindering the objectives and requirements of the WFD.

7.2.62 Overall the revised AoS identified that the revised draft Nuclear NPS is likely to be negative with regard to flood risk, primarily as a result of the need for additional flood defences and their effects on coastal processes and hydrodynamics over the long project lifetime for new nuclear power stations.

7.2.63 *The AoS recommended that the revised draft NPS should highlight to the IPC the need for detailed, site-specific investigations, including flood risk assessment, to determine the most appropriate and sustainable methods for protecting sites from flooding through the life cycle of the new nuclear power stations and to assess how these measures may affect flood risk in adjacent areas. Studies should also be undertaken to assess the impacts that any flood control measures may have on*

coastal processes and, indirectly, on ecology and biodiversity. Overall, the revised AoS identified that the effect of the draft NPS on flood risk and of flood risk on the sites in the revised draft NPS is likely to be negative, and the scale of the effects are likely to increase over time as a result of climate change.

Radioactive and Hazardous Waste

7.2.64 The revised draft Nuclear NPS sets out the Government's view that effective arrangements will exist for the management and disposal of radioactive waste that will be produced from new nuclear power stations. The AoS has considered the sustainability implications of managing the different types of waste associated with the construction, operation and decommissioning of new nuclear power stations in the UK under the following headings:

- Spent Fuel;
- Intermediate Level Waste (ILW);
- Low Level Waste (LLW);
- gaseous and liquid radioactive discharges; and
- non-radioactive hazardous waste.

7.2.65 The AoS has identified that the effects of waste management may arise both at a nuclear power station site and offsite at other locations where packaging, transport and/or disposal of waste is undertaken. Some minor negative effects have been identified at nuclear power station sites. These are principally associated with the management and storage of spent fuel and ILW. Minor negative effects may potentially arise during construction and decommissioning of interim waste storage facilities although some of these effects, for example on soils, cultural heritage and landscape are site specific and will need to be assessed at the project level.

7.2.66 The most important consideration for offsite waste management facilities is the additional quantity of spent fuel to be disposed of from new nuclear power stations that will require final disposal in a Geological Disposal Facility (GDF). The significance of the effects on the GDF will depend upon the number of new nuclear power stations built. The NDA has estimated the amount of spent fuel that would be generated by new nuclear power stations of either the AP-1000 reactor or EPR reactor being considered in the Generic Design Assessment (GDA). This assessment has indicated that a 10GW programme of new nuclear power stations operating for 60 years would increase by between 50-55% the amount of spent fuel and High Level Waste (HLW) to be disposed of in a GDF.

7.2.67 *In relation to the management of Spent Fuel and ILW at power station sites, the revised AoS (see Chapter 6) recommended that the revised draft Nuclear NPS should advise the IPC that the management of these radioactive wastes has the potential for effects on and off-site, including effects associated with transportation.*

7.2.68 *In addition, the AoS recommended that the revised draft Nuclear NPS suggest to the NDA that the effects of the additional volume of Spent Fuel and ILW from new nuclear power stations should be taken into account in their design and evaluation of a GDF, including transportation. It is not for the revised draft Nuclear NPS to*

direct the NDA in this way, however, the draft NPS makes it clear that the NDA is free to take account of anything set out in the draft NPS if it chooses to do so.

Significant transboundary effects

7.2.69 The Appraisal of Sustainability was informed by the views of both the Environment Agency and the Nuclear Installations Inspectorate, who advised that due to the robustness of the regulatory regime, there is a low probability of an unintended release of radiation. It is therefore considered that significant transboundary effects are unlikely.

7.2.70 Radioactive releases are strictly controlled in accordance with limits laid down in permits issued by the NII and the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2010. This regulatory system ensures that permitted radioactive discharges are within authorised limits.

7.2.71 The Environment Agency works with operators to ensure that these discharges are not only within the statutory limits but as low as reasonably achievable. The UK is also a contracting party to the OSPAR Convention on the Protection of the Marine Environment of the North East Atlantic. The revised radioactive discharges strategy published in 2009 demonstrates how the UK is continuing to meet the objectives of the Convention's Radioactive Substances Strategy. This includes the objective of progressive and substantive reductions in concentration of radionuclides in the marine environment resulting from discharges, so that by 2020 they add close to zero to historic levels.

7.2.72 The Euratom Treaty will also require the UK, at the site application stage, to submit to the European Commission information to enable it to determine whether the implementation of the plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State. This determination will include consideration of both planned disposals and accidental releases of radioactive substances. Permission to make radioactive discharges and disposals would not be given by the Environment Agency unless a favourable opinion has been received from the European Commission. Therefore, the regulatory regime will ensure that the current and future situation, with regard to radioactive disposals and waste in the UK and EU transboundary effects, will be maintained in accordance with international agreements.

7.2.73 There is a risk of an accidental release of radioactive emissions associated with new nuclear power stations which are built in line with the revised Nuclear NPS. However, the risk of such an accident is judged to be very small because of the strict regulatory regime in the UK. The nuclear regulatory bodies will need to be satisfied that the radiological and other risks to the public associated with accidental releases of radioactive substances are as low as reasonably practicable and within the relevant radiological risk limit. As part of the site licensing process, a potential operator will be required to demonstrate that the nuclear facility is designed and can be operated such that several levels of protection and defence are provided against significant faults or failures, that accident management and emergency preparedness strategies are in place and that all reasonably practicable steps have been taken to minimise the radiological consequences of an accident. Further detail about the regulatory regime is set out in Chapter 3 of this report.

7.3 Interactions and Cumulative Effects

7.3.1 Many of the factors for sustainable development and the revised draft Nuclear NPS are inter-related, particularly between biodiversity, water, climate change, energy, human health, and communities – their social and economic viability including supporting infrastructure and basic services. For example, new coastal and flood defence works may change the movement of sediments in the water, and this in turn may affect the ecology of a nearby wetland habitat. Cumulative and synergistic effects may arise from the interactions and additions of small insignificant effects. For example, synergistic effects may occur when a number of major developments occur in a sub-region so that the communities benefitting from them become more sustainable by reaching critical thresholds for services and infrastructure.

7.3.2 Any likely significant cumulative effects (negative and beneficial) and inter-relationships were identified and reported in the most relevant topic sections. Generally, the significance of these effects will depend upon the number of new nuclear power stations that are built, where they are built and when they are built. The AoS identified that this was likely where there are clusters of potentially suitable sites for new nuclear power stations. The revised AoS recommended that for the north west and south west of England, the revised draft NPS should advise the IPC to consider interactions and cumulative effects if more than one station is built as follows:

- north west of England: Heysham and Sellafield. The revised AoSs identified potential beneficial effects of regional significance on employment and community viability, with additional positive effects on health and well-being from secure employment.

- south west of England: Hinkley Point and Oldbury. The revised AoSs identified potential interactions and cumulative effects on important biodiversity sites in the Severn Estuary, River Wye and River Usk. Potential positive effects on local employment, upskilling, community viability and health/well-being could be more significant if more than one new nuclear power station is built.

- east of England: Bradwell and Sizewell: The revised AoS identified potential interactions and cumulative effects on important biodiversity in the Outer Thames Estuary SPA.

7.3.3 The revised AoS recommended that the IPC should consider the capacity of supporting infrastructure, such as non-radioactive waste, water, flood risk, and transport, together with the implications of phasing and timing of other infrastructure. It further recommended that the revised draft NPS should guide the IPC to consider cumulative effects on the natural environment, particularly when considered in combination with other planning objectives, such as for biodiversity.

7.3.4 The revised AoS recommended that the revised draft NPS should draw to the attention of the IPC, the opportunities for enhanced skills and expertise in the nuclear and associated industries where there are clusters of proposed suitable sites and in combination with regional development objectives.

7.4 The potentially suitable sites – generic findings

7.4.1 The detailed appraisal for each listed site is presented in the individual site revised AoS reports in Annexes A-H of this revised Main AoS Report. These site AoSs identified potential impacts and likely effects of a generic design of a new nuclear power station. They identified likely significant strategic and local effects and suggested possibilities for mitigation of significant negative effects, including recommendations made to inform the development of the revised draft NPS. The significance of local effects and identification of the most appropriate mitigation will depend upon detailed studies carried out as part of the project level EIAs and other studies for individual applications for development consent. The mitigation measures will be refined iteratively as part of the development of the proposals for the site.

7.4.2 The site AoSs recommended to the revised draft NPS that the findings of the site AoSs would be helpful to the IPC when scoping EIAs and other studies, and when considering applications for development consent. Annex C of the revised draft Nuclear NPS sets out the findings of the Strategic Siting Assessment (SSA) process for each potentially suitable site and includes the findings of the AoS where they are relevant against the SSA criteria, and other key findings of the site AoSs.

7.4.3 Some findings of the site AoSs are similar across all the sites and reflect the development characteristics of new nuclear power stations; these are summarised in the following paragraphs. Certain findings of the site AoSs were of particular note to individual sites and these are summarised in the subsequent following paragraphs. The potential for interactions and any cumulative effects, particularly where there could be clusters of new nuclear power stations, was also explored and likely significant effects reported.

AoS findings similar across the sites

7.4.4 The significance of many effects at the local and regional levels, together with the possibilities and effectiveness of mitigation, can only be identified through the detailed studies for the project level EIAs and other studies associated with the applications for development consent to the IPC.

7.4.5 There is the potential for positive interactions and cumulative effects associated with the creation of temporary jobs during construction and permanent long term employment, expansion of an energy hub with education and upskilling, and enhanced prosperity for local communities, including the secondary benefits for health and well-being associated with secure employment. This will only be significant for improving community viability if the employment is secured for local people.

7.4.6 *The AoS recommends that the revised draft NPS should guide the IPC to the findings of the site AoS and site HRA reports to help scope the studies needed at the project level to inform their decision making. The AoS suggested that the revised draft NPS should consider requesting a sustainability assessment/statement for each application to ensure full consideration of socio-economic issues as well as environmental issues addressed in EIA. This was not taken forward specifically by the revised draft Nuclear NPS as the revised Overarching Energy NPS requires applications to include assessment of socio-economic effects.*

7.4.7 Many of the likely significant effects identified by the site AoSs are characteristic of major infrastructure projects, for example, noise, dust and disturbance during the construction phases. These generic impacts are dealt with in the revised Overarching Energy NPS and this was subject to revised AoS (see earlier in chapters 1 and 2).

7.4.8 *The revised AoS recommends that the revised draft NPS should advise the IPC that a requirement for an Environmental Management Plan as part of the EIA scoping will help ensure that any commitments to mitigating any significant impacts will be implemented.*

7.5 The potentially suitable sites - key findings for each site

7.5.1 The following section sets out a summary of the environmental characteristics of the eight sites listed in the revised draft Nuclear NPS which are likely to be affected by development, a summary of the potential likely effects and possible mitigations which were identified. A more detailed analysis can be found in the AoS site reports (Annexes A-H) for each site which can be found at www.energynpsconsultation.decc.gov.uk.

Bradwell

7.5.2 The site at Bradwell is located in the east of England, to the east and south of the existing Bradwell nuclear power station and on the south side of the Blackwater Estuary at the northern extremity of the Dengie Peninsular. The site comprises largely arable farmland, a former military airfield, some agricultural buildings and areas of foreshore. There are 16 European protected sites within 20km of the site at Bradwell and ten scheduled monuments, one Conservation Area and around 132 listed buildings within an approximate distance of 5km of the site. It is situated in a rural area close to the village of Bradwell-on-Sea. The Bradwell area has supported nuclear power facilities since the 1960s.

7.5.3 There are potential negative effects on five national and internationally protected nature conservation sites (including the Essex Estuaries SAC, the Blackwater Estuary, the Dengie SPA/Ramsar and the Outer Thames Estuary SPA) and effects on water quality and fish/shellfish populations in nearby coastal waters due to the abstraction and release of sea water for cooling. Possible mitigation measures include: careful design and siting of cooling systems to minimise impacts; and suitable design, location and construction methods for flood defence works. Part of the site is at high risk of coastal flooding and there are both hard and soft flood defences already in place, but these may require upgrading over the lifetime of a new power station. This could have potential effects on erosion and visual appearance of the coastline. These effects are significant, but mitigation opportunities are likely to be available following further study.

7.5.4 A new nuclear power station would be set in the context of the existing power station at Bradwell, but the surrounding area is predominantly undeveloped and there is limited potential for mitigation of the negative impact on the local landscape. There are no significant negative effects anticipated on nationally designated landscapes.

7.5.5 Potential setting effects upon nearby scheduled monuments and listed buildings, and the West Mersea Conservation Area, could also be of regional or national importance, depending on distance and sight lines. The impact on the setting of Othona Roman fort and St Peter's Chapel would be significant. However, mitigation could be applied by siting the proposed facility close to the existing power station on the western side of the nominated site and through appropriate landscaping. Detailed assessment will be required at the project level EIA stage. It is recognised that adverse effects would be difficult to mitigate.

7.5.6 Bradwell is not close to any other nominated site and therefore does not form part of a cluster. This means that regional cumulative impacts are not considered relevant for this site. However, the potential for adverse effects from Bradwell and Sizewell on the European designated site of the Outer Thames Estuary indicates that there may be interactions and cumulative effects on biodiversity due to adverse effects on water quality and resources, habitat loss and disturbance.

Hartlepool

7.5.7 The site at Hartlepool is located in the north east of England in an established industrial area. The site surrounds the existing Hartlepool nuclear power station and is located at the mouth of the River Tees, on the north side of Greatham Creek, opposite Seal Sands. There are eight European protected sites within 20km of the site. The Teesmouth area is predominantly industrial with an established oil and chemicals industry.

7.5.8 Teesmouth and Cleveland Coast is designated as a Special Protection Area for birds and a Ramsar wetland site. There are potential negative effects on at least seven national and internationally protected conservation sites including Teesmouth and Cleveland Coast, and the Seaton Dunes and Common SSSI. Possible mitigation measures include: designing a suitable intake/outfall system; including fish protection measures; minimisation of effects on sedimentary processes or thermal regime; and the use of sensitive construction techniques.

7.5.9 There are potential negative effects on water quality and migratory fish in the region due to the abstraction and release of sea water for cooling. There are potential negative effects on coastal erosion and visual appearance principally as a result of new coastal flood defences that would be required to protect against sea level rise during the lifetime of the nominated site. These effects are significant but mitigation opportunities are likely to be available.

7.5.10 The development of a new nuclear power station will have a negative visual impact on the landscape and could potentially be seen from parts of the North York Moors National Park and Cleveland Heritage Coast. This impact could not be fully mitigated. However, the nominated site is adjacent to an existing nuclear power station in an area that is already heavily industrialised and so the additional impact on the landscape would be less significant at a regional level. There is some potential for mitigating visual impact through sensitive siting, colouring, and detailed building design, including application of principles of good design in accordance with PPS1.

7.5.11 There are likely to be positive local effects from employment generated by the development although the regional and national effects are considered to be small.

7.5.12 Hartlepool is not close to any other nominated site and therefore does not form part of a cluster. This means that regional cumulative impacts from sites included in the revised draft Nuclear NPS are not considered relevant for this site.

Heysham

7.5.13 The site at Heysham is located in the north west of England, on the Lancashire coast south of Morecambe Bay and 8km west of Lancaster. The site is to the east of the existing Heysham nuclear power station (which has been operational since 1983) and adjacent to Heysham Docks. The site occupies an area of drained marsh at the western side of a generally low lying area of land between the River Lune and Morecombe Bay and is adjacent to residential and industrial areas with grazing land to the east. There are 19 SSSIs within 16km and 10 European protected sites within 20km of the site.

7.5.14 There are potential negative effects on three national and internationally protected nature conservation sites. The site lies in the mouth of the Lune Estuary which is a designated SSSI, and overlaps with the Morecambe Bay European Marine Site.

7.5.15 There are also potential negative effects on water quality in the region due to the abstraction and release of sea water for cooling. River and coastal flood defence schemes already exist in the area of the nominated site, but these may need to be upgraded to protect against sea level rise and coastal erosion during the lifetime of the facility. These effects are significant, but mitigation opportunities are likely to be available following further study. Possible mitigation measures include: seeking to avoid the need to disturb sensitive areas where possible; requiring studies to ensure that local groundwater bodies are investigated; and suitable design is adopted to avoid or mitigate potential impacts on sensitive habitats and species.

7.5.16 The development of a new nuclear power station will have a negative visual impact on the landscape and could potentially be seen from parts of the Lake District National Park. This impact could not be fully mitigated, however, the nominated site is adjacent to an existing nuclear power station, in an area that is already heavily industrialised, and so the additional impact on the landscape would be less significant at a regional level. Possible mitigations include appropriate landscaping/planning schemes. There is some potential for mitigating visual impact through sensitive siting, colouring, and detailed building design, including application of principles of good design in accordance with PPS1. However, this is limited given the size of the buildings.

7.5.17 Positive effects of regional economic significance may occur when the project is considered cumulatively with other energy projects in the north west. The Heysham site is adjacent to an existing rail link and sea port, which presents opportunities for sustainable transport, particularly during construction.

7.5.18 Heysham is approximately 60km from the nominated site at Sellafield. The possible positive socio-economic effects discussed above could be enhanced if both the sites were developed.

Hinkley Point

7.5.19 The site at Hinkley Point is located in the south west of England, on the Severn Estuary and Somerset coast, and to the west and south of the Hinkley Point A and B

nuclear power stations. Hinkley Point has supported nuclear power facilities since 1965. The site is bounded by the Severn Estuary to the north, the Quantock Hills to the south and west, and the Polden Hills to the east. The River Parrett lies to the north. The surrounding land is predominantly agricultural, and is sparsely populated with a few rural villages. There are eight European protected sites within 20km of the site. Located within 5km of the site, to the west and south west, is the Quantock Hills AONB which covers 99km from the Vale of Taunton Deane to the Bristol Channel. The AONB consists of large amounts of heathland, oak woodlands, ancient parklands and agricultural land.

7.5.20 Potential negative effects on protected conservation sites and designated species, including those in the Severn Estuary and Bridgwater Bay[224]. There is the potential for negative effects on water quality and migratory fish populations caused by the abstraction and release of cooling water, and a risk from coastal flooding. Existing flood defences are in place, but may need upgrading during the lifetime of the facility. Mitigation opportunities are likely to be available for the above following further study and include: ensuring fish protection in cooling water intake/system design and the implementation of a Construction Environmental Management Plan to avoid or minimise disturbance to wildlife.

7.5.21 There is an existing nuclear power station at Hinkley Point, but a new power station would have additional negative visual impact on views from the Quantock Hills AONB at a sub-regional level which could not be fully mitigated. Possible mitigation includes clustering of new and proposed buildings to avoid broadening the potential visual impact and using existing screening woodland with protective buffer zones, and application of principles of good design in accordance with PPS1.

7.5.22 There is the potential for significant negative cumulative effects if two new power stations (Hinkley Point and Oldbury) and any Severn Tidal Power project are all developed. The potential effects of the latter project are likely to be more significant than two new nuclear power stations. These include the loss of nationally and internationally important estuarine habitats, where the possibility of full mitigation is unlikely.

7.5.23 There is also potential for positive cumulative effects associated with long term employment and enhanced prosperity for communities at the sub-regional level if both power stations are built in the Severn Estuary.

Oldbury

7.5.24 The site at Oldbury is located on the south side of the Severn Estuary in the south west of England. The site is located to the north of the existing Oldbury nuclear power station, approximately 1.5km from the village of Oldbury-on-Severn and 24km north east of Bristol. The south western part of the site comprises silt lagoons (part of the existing nuclear power station site) and the remainder is agricultural land. To the west, the site is bounded by the existing flood defences of the Severn Estuary. Some additional infrastructure may also be required outside the site, including additional flood protection measures and cooling water intake and outfall structures. The land in the area surrounding Oldbury is predominantly used for agriculture.

[224] The internationally protected conservation sites are Severn Estuary SAC, Severn Estuary SPA, Severn Estuary Ramsar, River Wye SAC, River Usk SAC. The nationally protected conservation sites are Bridgewater Bay SSSI/NNR, Severn Estuary SSSI, Lower Wye SSSI and Lower Usk SSSI.

There are seven European protected sites within 20km and four Scheduled Monuments, one registered park and garden (Berkeley Castle), one Conservation Area and 250 listed buildings within an approximate distance of 5km of the site.

7.5.25 There are potential negative effects on five internationally protected conservation sites[225] and three nationally protected conservation sites[226]. The area is a high risk flood zone. Existing flood defences are in place, but these are likely to need upgrading to protect against sea level rise and erosion during the lifetime of the facility. These effects are significant, but mitigation opportunities are likely to be available following further study. Possible mitigation measures include: incorporation of fish protection measures within cooling water intake system design; minimising the need for encroachment of construction into sensitive habitat areas through site design; and implementation of a construction Environmental Management Plan to minimise disturbance, e.g. through timing of construction programmes and visual/noise screening.

7.5.26 Due to the large tidal range the existing power station needs a tidal reservoir to allow for continual abstraction and release of cooling water. The capacity of the Severn Estuary at this location is insufficient for a new larger nuclear power station, and cooling towers are therefore required. Although adjacent to the existing nuclear power station the cooling towers would be visible from parts of the Wye Valley and the Cotswolds AONB. The significance of the effects would depend upon the size of the cooling towers. The nominator of the site, Horizon Nuclear Power, has stated that its preferred cooling option is a hybrid cooling system which would utilise cooling towers with a height of around 70 metres.

7.5.27 There is the potential for significant negative cumulative effects if two new power stations (Hinkley Point and Oldbury) and any Severn Tidal Power project are all developed. The potential effects of the latter project are likely to be more significant than two new nuclear power stations. These include the loss of nationally and internationally important estuarine habitats, where the possibility of full mitigation is unlikely.

7.5.28 There is also potential for positive cumulative effects associated with long term employment and enhanced prosperity for communities at the sub-regional level if both new nuclear power stations are built in the Severn Estuary area.

Sellafield

7.5.29 The site at Sellafield is located in the north west of England, adjacent to the existing nuclear facilities and in a coastal location that has supported nuclear power facilities since 1956, and is now an established area for the nuclear industry. Apart from the existing nuclear facility, no other current industrial land use is present in the immediate area and the surrounding area is largely agricultural. The boundary of the Lake District National Park is 1.5km to the east and 5km to the south of the site. The existing Sellafield nuclear facility and infrastructure is a dominant feature of the this area of coastline and is visible from the surrounding hills and from the Isle of Man. There are six European protected sites within 20km of the site. Legally protected species within the area include great crested newts, with presence records of natterjack toad, otter, red squirrel and common species of reptile falling within 10km

[225] Severn Estuary SAC, Severn Estuary SPA, Severn Estuary Ramsar, River Wye SAC, River Usk SAC
[226] Severn Estuary SSSI, Lower Wye SSSI and Lower Usk SSSI

of the site. Nationally important invertebrate species and rare and common plants are also known to occur.

7.5.30 This site lies on the Cumbrian coast and the AoS has identified potential negative effects on three protected nature conservation sites in the region, including Drigg Coast SAC and the River Ehen SAC. There are potential significant negative effects on water quality and migratory fish in nearby coastal waters due to the abstraction and release of sea water for cooling. Possible mitigation includes further water quality studies to determine the impacts, monitoring, careful design of the site to avoid entering sensitive areas, and suitable design and location of coastal and fluvial flood defence works and the marine landing station.

7.5.31 The risk of flooding due to rising sea levels is considered relatively low at Sellafield and existing hard flood defences are in place, which may require upgrading. Mitigation opportunities are likely to be available following further study.

7.5.32 The development would be visible from parts of the Lake District National Park and the impact could not be fully mitigated. However, this would be set in the context of the extensive existing nuclear facilities at Sellafield, and so the additional impact on the landscape would be less significant at the strategic level. Possible mitigation includes detailed siting of main buildings to minimise visual impacts and application of the principles of good design in accordance with PPS1.

7.5.33 Sellafield is approximately 60km north west of the potentially suitable site at Heysham. The possible positive socio-economic effects discussed above could be enhanced if both the sites were developed.

Sizewell

7.5.34 The site at Sizewell is located adjacent and to the north of the existing Sizewell B nuclear power station near Leiston, Suffolk, in the east of England. The site lies on the Suffolk Heritage Coast and is wholly within the Suffolk Coast and Heaths AONB, both of which are national designations for protecting areas of special scenic, landscape and environmental value from undesirable development. The site also includes part of the Sizewell Marshes SSSI and land in the Goose and Kenton Hills. There are 13 European protected sites within 20km of the site. Although the proposed development would be set in the context of the existing nuclear power station, it may have a direct and long term negative visual impact on a nationally designated landscape and this could not be fully mitigated.

7.5.35 There are potential negative effects on at least five national and internationally protected nature conservation sites, including Minsmere to Walberswick Heaths SPA and Ramsar sites, Sizewell Marshes SSSI and the Outer Thames SPA. Construction and the presence of development are likely to lead to direct loss and fragmentation of priority terrestrial and coastal habitats and wildlife corridors for protected species. There is potential for mitigation or compensation of biodiversity effects, including the creation of replacement habitat and maintaining the connectivity of wildlife corridors for certain species around the site. Possible mitigation measures include: avoidance of the need to develop in or disturb sensitive areas; suitable design and location of coastal and fluvial flood defence works and the marine landing station; suitable construction methods; and suitable design and location of the cooling water abstraction and discharge points.

7.5.36 There are potential negative effects on water quality and fish/shellfish populations in nearby coastal waters due to the abstraction and release of sea water for cooling. The nature and significance of these effects will be explored in project level studies; mitigation possibilities include the incorporation of fish protection measures.

7.5.37 There are existing sand and shingle flood defences in place, which may require upgrading to protect the site for the full lifetime of a new nuclear power station, with secondary, indirect and likely significant effects on coastal erosion and the visual appearance of the coastline. Mitigation opportunities through appropriate design and construction of the flood defences are likely to be available following detailed project level studies.

7.5.38 Sizewell is not close to any other nominated site and therefore does not form part of a cluster. This means that regional cumulative impacts are not considered relevant for this site. However, the potential for adverse effects from Bradwell and Sizewell on the European designated site of the Outer Thames Estuary indicates that there may be interactions and cumulative effects on biodiversity due to adverse effects on water quality and resources, habitat loss and disturbance.

Wylfa

7.5.39 The site at Wylfa is located at Wylfa Head, which extends into the Irish Sea from the north coast of the Isle of Anglesey, 15km north east of Holyhead between Cemaes and Cemlyn Bays. It includes the headland south of Mynydd-y-Wylfa local nature reserve and extends eastwards to the western outskirts of the villages of Cemaes and Cemaes Bay. The site is located to the south east and to the east of the existing nuclear power station. The Wylfa site has supported nuclear power facilities since 1971. There are nine European protected sites within 20km of the site. Tre'r Godf SSSI lies within the bouindary of the site and this is a rich fen habitat which supports nationally scarce plants and is considered a representative example of this habitat type within north west Wales. Early indications of legally protected species within 10km of the site include bat species and common species of reptile and choughs.

7.5.40 There are potential negative effects on at least four national and internationally protected nature conservation sites, including Cemlyn Bay SAC, the Yns Feurig, Cemlyn Bay and the Skerries SPA. These effects are potentially significant, but mitigation opportunities are likely to be available following further study. Possible mitigation measures include: implementation of a construction Environmental Management Plan to avoid/minimise disturbance to wildlife; minimising habitat loss and preventing water pollution; ensuring fish protection in cooling water intake/system design; and avoidance of sensitive areas.

7.5.41 The site is predominantly located on higher ground with hard bedrock. The risks from coastal flooding, sea level rise and erosion are therefore considered to be low. However, further assessment is required to determine the need for additional defences over the lifetime of a new nuclear power station.

7.5.42 Coastal water conditions at the site are considered generally favourable for the dispersion of the heated water that would be released after cooling.

7.5.43 The development of a new nuclear power station will have a negative visual impact on the local and sub-regional landscape, particularly the Anglesey AONB (part of which lies within the nominated site boundary) and North Anglesey Heritage Coast.

Currently, the exact location of the new nuclear power station buildings is unknown as a large site has been nominated, but some negative impact, which may not be fully mitigated, is anticipated.

7.5.44 There is also potential for positive effects associated with long term employment and enhanced prosperity for communities at the local level.

7.5.45 Wylfa is not close to any other nominated site and therefore does not form part of a cluster. This means that regional or sub-regional cumulative impacts are not considered relevant for this site.

7.6 Summary of revised AoS findings

7.6.1 Nationally and generally at the strategic level, the revised AoS identified that the revised draft Nuclear NPS was likely to have significant beneficial effects for energy security of supply and a positive contribution to the Government's targets for a low carbon economy, reducing emissions of greenhouse gases and mitigating the predicted effects of climate change. Likely significant adverse effects were indicated for internationally and nationally important nature conservation sites. The details of the significance of these effects and any appropriate mitigation will be determined through detailed studies as part of the project level EIAs and HRAs to accompany the individual applications for development consent to the IPC.

7.6.2 The construction of new nuclear power stations, in line with the revised draft NPS, is not likely to have any significant transboundary effects. The AoS identified the possibility of transboundary effects in the event of a significant unintended release of radioactive emissions e.g. as a result of an accident. The AoS has been informed by the views of both the Environment Agency and the Nuclear Installations Inspectorate, who advised that due to the robustness of the regulatory regime, there is very low probability of an unintended release of radiation. This is based on expert judgement and experience supported in the case of the new nuclear power reactor designs by the regulators' findings so far from Generic Design Assessments.

7.6.3 At local and regional levels, likely significant negative and beneficial effects were identified and their significance depends upon further local investigations; these will be carried out in more detail with the project level EIA studies. Generally, likely significant negative effects were associated with landscape, cultural heritage, biodiversity, water and the capacity of supporting infrastructure such as waste and transport facilities; likely significant beneficial effects were associated with employment and community viability. There were particular considerations for the north west and the south west of England where two new nuclear power stations may be developed in each area.

Chapter 8. Monitoring and Next Steps

8.1 Monitoring

8.1.1 Monitoring helps to examine the predicted effects (identified through the AoS process) against the actual effects of the Nuclear NPS when it is implemented e.g. when infrastructure is constructed and operational.

8.1.2 The Government has published a draft monitoring strategy for public consultation which covers all the energy NPSs including nuclear[227]. EN1-5 are not spatially specific and therefore the precise location, type and quantity of proposed energy infrastructure developments that will be granted development consents, or licences to operate, is not known. Accordingly there are a wide range of potential effects that may occur and that will depend on a number of factors including; the speed and proportion of infrastructure development that is successfully developed across the range of energy sectors; and the application of mitigation measures as set out in the NPSs. Monitoring is, therefore, most effectively focused on environmental and socio-economic trends. At a strategic level the lack of spatial definition means that it may not be possible to attribute changes (improvements or deterioration) in trends directly to any one individual NPS.

8.1.3 The Government proposes to make use of existing monitoring where possible. Key possible indicators/measures for monitoring the sustainability effects of the Nuclear NPS could include:

- the condition of European protected sites, Marine Protected Areas and SSSIs identified as potentially affected by development;
- emissions of air pollutants: NOx, SOx, and PM_{10}; and
- areas at risk of flooding (fluvial, groundwater, sea level rise).

8.1.4 The sustainability effects of the Nuclear NPS (which is locationally specific) could be monitored through the monitoring frameworks already carried out by the environmental, nuclear and health regulators, and local authorities. The extent of nuclear generating activities will be monitored through the nuclear licensing procedures. Pollution control and environmental management monitoring is carried out by the environmental authorities and human health protection is through the health authorities. Regional Planning Bodies and Local Planning Authorities monitor the effectiveness of their spatial plans, including indicators such as employment and access to community facilities and services.

8.1.5 The draft monitoring strategy sets out a number of possible indicators for monitoring. The Government will take into account any consultation comments on the draft monitoring strategy and make any appropriate changes. The final

[227] www.energynpsconsultation.decc.gov.uk

monitoring strategy will be set out in the AoS Statement that will be published alongside the final, designated Nuclear NPS[228].

8.2 Next steps

8.2.1 The revised draft Nuclear NPS, the revised AoS and HRA Reports will be available for review and public comment for a period of 14 weeks from the date of publication. The documents are available on the DECC consultation website www.energynpsconsultation.decc.gov.uk and details of how to comment are set out in the Consultation Document[229].

8.2.2 The Government will consider comments received during the public consultation and the Nuclear NPS will be subject to ratification by Parliament before final designation. On designation of the Nuclear NPS, an AoS Statement will be published and this will outline how the findings of the AoS and the responses to consultation have been taken into account. It will also provide further information on how monitoring will be carried out.

[228] All the energy NPSs will be ratified by Parliament before final designation.
[229] https://www.energynpsconsultation.decc.gov.uk

Technical Glossary

As Low As Reasonably Achievable (ALARA)	Radiological doses or risks from a source of exposure are “As Low As Reasonable Achievable” when they are consistent with the relevant dose target or target standard and have been reduced to a level that represents a balance between radiological and other factors, including social and economic factors. The level of protection may then be said to be optimised.
As Low As Reasonably Practicable (ALARP)	To satisfy the ALARP principle, measures necessary to reduce risk must be taken until or unless the cost of those measures, whether money, time or trouble is disproportionate to the reduction in risk.
Becquerel (Bq)	The standard international unit of radioactivity equal to one radioactive transformation per second.
Best Available Technique (BAT)	Best Available Technique (BAT) is defined in the EU Directive on Integrated Pollution Prevention and Control 96/61/EC as: • 'best available techniques' shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole: 'Techniques' shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned, • 'Available' techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator, • 'Best' shall mean most effective in achieving a high general level of protection of the environment as a whole.
Best Practicable Environmental Option (BPEO)	BPEO was described by the Royal Commission on Environmental Pollution Twelfth Report (Cm 210) 1988 as “the outcome of systematic and consultative decision making procedure which emphasises the protection and conservation of the environment across land, air and water. 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”.

Best Practicable Means (BPM)	BPM is the term used by the Environment Agencies in authorisations issued under RSA93. 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. BPM is applied to such aspects as minimising waste creation, abating discharges and monitoring plant discharges and the environment. RSA93 still applies in Scotland and Northern Ireland. In England and Wales, it has been replaced by the Environmental Permitting (England and Wales) Regulations 2010.
Committee on Radioactive Waste Management (CoRWM)	Independent body first established by UK Government and Devolved Administrations in November 2003 to recommend the best option or combination of options for the long term management of Intermediate Level Waste (ILW) and High Level Waste (HLW)
Decommissioning	The process whereby a nuclear facility, at the end of its operating life, is taken permanently out of service and its site made available for other purposes
Disposal	Means emplacement of spent fuel or radioactive waste in an appropriate facility without intention of retrieval
Dose	The measure of radiation received. Various forms of dose are commonly referred to as equivalent dose, effective dose and absorbed dose. Dose is measure in Sieverts (effective and equivalent) and Grays (absorbed)
Dose Constraint	The restriction on annual dose to an individual from a single source such that when aggregated with doses from other sources, excluding natural background and medical procedures, the dose limit is not likely to be exceeded.
Dose Limit	1 mSv/y to members of the public from all man-made sources of radiation.
Encapsulation	A conditioning process in which radioactive waste is physically enclosed in a non-radioactive material that prevents radionuclides from moving.
Immobilisation	A conditioning process in which radioactive waste is chemically incorporated into a non-radioactive materials so that radionuclides cannot move.
Interim Store	Storage of radioactive waste prior to implementing a final management step, such as geological disposal.
Intermediate Level	Radioactive waste exceeding the upper activity boundaries for

Waste (ILW)	LLW but which do not need heat to be taken into account in the design of storage or disposal facilities.
Ionising Radiation Regulations (IRR)	UK Regulations that require the employers to keep exposure to ionising radiations as low as reasonably practicable. Exposures must not exceed specified dose limits.
Legacy waste	Radioactive waste that already exists or whose arising is committed in future by the operation of an existing nuclear power station.
Low Level Waste (LLW)'	Radioactive waste having a radioactive content not exceeding 4 gigabecquerels per tonne (GBq/te) of alpha or 12 GBq/te of beta/gamma activity.
Nuclear Waste '	General term for the radioactive waste produced by those industries involved with nuclear energy and nuclear weapons' production. It includes LLW, ILW and HLW from nuclear power stations.
Sievert (Sv)	Unit of radiation dose recommended by the International Commission on Radiation Protection. It takes into account the energy absorbed in the tissue concerned, and the biological effects of the different radiations.
Spent fuel	Used fuel assemblies removed from nuclear power plant reactors after several years use and treated either as radioactive waste or via reprocessing as a source of fissile material.
Substances of Low Activity (SoLA)	Exemption order which exempts radioactive material containing <0.4 Bq/g from certain provisions under RSA93 relating to waste accumulation and disposal.
Very Low Level Waste (VLLW)	Waste with a very low concentrations of radioactivity: • Low volumes of VLW is radioactive waste which can be safely disposed to unspecified destination with municipal, commercial or industrial waste, each 0.1 m^3 of waste containing less than 400 kilobecquerels (kBq) of total activity or single items containing less than 40 KBq of total activity • High volume VLLW is radioactive waste with maximum concentrations of 4 megabecquerels per tonne (MBq/te) of total activity which can be disposed of to specified landfill sites
Waste management hierarchy'	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.

Waste Package	A container and all its contents

List of Abbreviations

AA	Appropriate Assessment
ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
AONB	Areas of Outstanding Natural Beauty
AoS	Appraisal of Sustainability
AoS Report	Report setting out environmental and sustainability effects of the Nuclear NPS. It will incorporate the requirements of the SEA Directive
BAP	Biodiversity Action Plan
BAT	Best Available Techniques
Bq	Becquerel - The standard international unit of radioactivity equal to one radioactive transformation per second
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means
CCGT	Combined Cycle Gas Turbine
CCW	Countryside Council for Wales
CEA	Cumulative Effects Assessment
CO_2	Carbon Dioxide
COMARE	Committee on Medical Aspects of Radiation in the Environment
CoRWM	Committee on Radioactive Waste Management
cSAC	Candidate Special Area of Conservation
CWS	County Wildlife Site
DECC	Department of Energy and Climate Change
Defra	Department for the Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
EU	European Union
GDA	Generic Design Assessment
GHG	Greenhouse Gas
HLW	High Level Radioactive Waste
HPA	Health Protection Agency
HRA	Habitats Regulations Assessment
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Radioactive Waste
IRR	Ionising Radiation Regulations
IMD	Index of Multiple Deprivation
IPC	Infrastructure Planning Commission.
LLW	Low Level Radioactive Waste
LNR	Local Nature Reserves
LPA	Local Planning Authority
mSv	Millisievert
NII	Nuclear Installations Inspectorate
NPS	National Policy Statement
NSA	National Scenic Area
OCNS	Office for Civil Nuclear Security

OECD	Organisation for Economic Co-operation and Development
OSPAR	Oslo and Paris Conventions
PPS	Planning Policy Statement
SA	Sustainability Appraisal
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SO2	Sulphur Dioxide
SPA	Special Protection Area
SSA	Strategic Siting Assessment
SoLA	Substances of Low Activity
Sv	Sievert - Unit of radiation dose recommended by the International Commission on Radiation Protection.
UN	United Nations
VLLW	Very Low Level Waste

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