Environment Agency

Generic design assessment

UK EPR^{TM} nuclear power plant design by AREVA NP SAS and Electricité de France SA

Final assessment report

Other environmental regulations

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Protective status	This document contains no sensitive nuclear information or commercially confidential information.
Process and Information Document[1]	The following sections of Table 1 in our Process and Information Document are relevant to this assessment: 3.1 – water abstraction 3.2 – water discharge of non-radioactive substances 3.3 – standby generation 3.4 – Control of Major Accident Hazards Regulations
Radioactive Substances Regulation Environmental Principles[2]	Not directly relevant to this report
Report author	Green, R.

1. Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Environment Agency, Jan 2007.

   http://publications.environment-agency.gov.uk/pdf/GEHO0107BLTN-e-e.pdf

2. Regulatory Guidance Series, No RSR 1: Radioactive Substances Regulation - Environmental Principles (REPs), 2010.

   http://publications.environment-agency.gov.uk/pdf/GEHO0709BQSB-e-e.pdf

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Summary

1 In GDA we focused our main assessment effort on radioactive waste matters but we also considered other environmental matters where the Environment Agency has a regulatory role:

a) Abstraction of water – use of water taken from the open sea for cooling is unlikely to require an abstraction licence from us but the design of the seawater intake to minimise damage to marine life will be a site-specific issue.

b) The discharge of aqueous effluents will require a permit from us. The indications from GDA are that it should be possible for us to issue a permit for the discharge from a UK EPR™, dependent on the outcome of site specific dispersion modelling.

c) A UK EPR will not make direct or indirect discharges to groundwater in normal operation and will not require a groundwater permit from us. Pollution prevention techniques used in the UK EPR should prevent any leaks or spills entering groundwater.

d) The emergency diesel generators on a UK EPR will require a combustion activities permit from us. The indications from GDA are that we should be able to permit the generators but as diesel engines are not chosen until late stages of construction, the operator of a UK EPR will need to demonstrate to us that the chosen engines are BAT.

e) The strategy proposed by EDF and AREVA for managing wastes is consistent with the waste hierarchy and the Waste Framework Directive objective that waste management is carried out without endangering human health and without harming the environment.

f) Future operators will need to produce a site waste management plan for each of their construction projects with an estimated cost greater than £300,000 under SWMPR 08.

g) The UK EPR will be a lower tier installation under the Control of Major Accident Hazards Regulations (COMAH). This will be on the basis of storage of more than 0.5 tonne of hydrazine hydrate – a named carcinogen under COMAH. However the risk of a Major Accident to the Environment (MATTE) from an accident involving hydrazine is highly unlikely.

h) A UK EPR will need a greenhouse gas emissions permit from us, under the EU Emissions Trading Scheme, for its total 82.4 MW of combustion plant (emergency diesel generators).

2 Our findings on the wider environmental impacts and waste management arrangements for the UK EPR reactor may be found in our Decision Document (Environment Agency, 2011a).

1 Introduction

3 We originally published this report in June 2010 to support our GDA consultation on the UK EPR design. The consultation was on our preliminary conclusions. It began on 28 June 2010 and closed on 18 October 2010.

4 We received additional information from EDF and AREVA after June 2010 and also undertook additional assessment in response to consultation responses. This report is an update of our original report covering assessment undertaken between June 2010 and the end of March 2011 when EDF and AREVA published an update of their submission. Where any paragraph has been added or substantially revised it is in a blue font.

5 We do not specifically deal with consultation responses in this report, they are covered in detail in the Decision Document (Environment Agency, 2011a). However, where a response prompted additional assessment by us this is referenced, the key to GDA reference numbers is in Annex 7 of the Decision Document. The conclusions in this report have been made after consideration of all relevant responses to our consultation.

1.1 Assessment Methodology

6 The basis of our assessment was to:

a) read appropriate sections of the EDF and AREVA Pre-Construction Environmental Report (PCER) and its supporting documents;

b) hold technical meetings with EDF and AREVA to clarify our understanding of the information presented and explain any concerns we had with that information;

c) raise Regulatory Observations and Technical Queries where we believed information provided by EDF and AREVA was insufficient;

d) assess the information provided by EDF and AREVA using our relevant internal guidance and regulatory experience and form conclusions.

e) decide on any GDA Issues or assessment findings to carry forward from GDA in our Statement of Design Acceptability, if issued.

1.2 EDF and AREVA GDA submission

7 Guidance on our generic design process (GDA) was published in January 2007 (process and information document (P&ID) (Environment Agency, 2007)). Table 1, references 3.1 to 3.4 of the P&ID sets out the information we require on environmental matters other than radioactivity.

8 EDF and AREVA provided their submission to GDA in August 2007. We carried out our initial assessment and concluded we needed additional information. We raised a Regulatory Issue on EDF and AREVA in February 2008 setting out the further information that we needed. In particular we believed P&ID reference 1.5 had not been addressed by the submission and required “a formal BAT assessment for each significant waste stream”.

9 EDF and AREVA completely revised their submission during 2008 and provided a Pre-Construction Environmental Report (PCER) with supporting documents.

10 We assessed information contained in the PCER but found that while much improved from the original submission it still lacked the detail we require to demonstrate BAT is used.

11 We raised 33 Technical Queries (TQs) on EDF and AREVA during our assessment. Two were relevant to this report:

a) TQ-EPR-224: Monitoring of liquid effluents;

b) TQ-EPR-227: Non-radioactive discharges.

12 EDF and AREVA responded to all the TQs. They reviewed and updated the PCER in March 2010 to include all the relevant information provided by the Regulatory Observations (ROs) and TQs up until then. This version of the PCER was referenced by our Consultation Document and publicly available on the UK EPR website.

13 Additional information on some topics was submitted by EDF and AREVA after March 2010. EDF and AREVA reviewed and updated the PCER to include all submitted information in March 2011. This report only uses and refers to the information contained in the updated PCER and its supporting documents, publicly available on the UK EPR website (http://www.epr-reactor.co.uk).

2 Water Resources Act 1991 (as amended): Water abstraction

14 The supply of water is limited, so we make sure that it's managed and used effectively to meet the needs of people and the natural environment. We do this through a licensing system. You can find out more on our website: Environment Agency - Water abstraction

2.1 Assessment Objectives

15 Our assessment was aimed at:

a) Understanding the requirements for water use in the UK EPR.

b) Identifying the sources of water to be used.

c) Deciding whether any licences or permits might be required for water abstraction.

d) Deciding whether the choice of cooling option(s) proposed for the generic site was appropriate.

e) Identifying any issues connected with water use.

2.2 EDF and AREVA documentation

16 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER-Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03
UKEPR-0003-090	PCER – Chapter 9 – Principles and methods used for environmental approach at the design stage	02
UKEPR-0003-120	PCER – Chapter 12 – Non radiological impact assessment	02

17 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

2.3 Assessment

18 The UK EPR is a pressurised water reactor (PWR), based around a primary circuit, a secondary circuit and a cooling circuit. Water requirements of the plant are set out in the following paragraphs.

2.3.1 Freshwater

19 EDF and AREVA say that since the UK EPR is located at a coastal or estuarine site there is no need for freshwater for heat sink (cooling) purposes. (PCERsc3.4s1)

20 EDF and AREVA say that the UK EPR will need supplies of freshwater for several purposes (PCERsc3.4s1.1):

a) To supply the demineralisation plant that provides treated water for the primary and secondary circuits. The UK EPR will need 410 $m^3 d^{-1}$ demineralised water in normal operation and 1100 $m^3 d^{-1}$ during start-up. The estimate for annual volume is 150,000 m^3.

b) Untreated freshwater for the industrial water system in the turbine hall used to wash floors and reduce overheating in the secondary effluent system (estimate 75,000 $m^3 y^{-1}$). Also used in the pumping station for spraying the circulation water pumps' stuffing boxes (estimate 40,000 $m^3 y^{-1}$).

c) Filtered freshwater to wash sand filters and regenerating and flushing the ion exchangers of the demineralisation plant (estimate 36,000 $m^3 y^{-1}$).

d) Potable water for sanitation needs (showers and lavatories), for the laundry and for firewater and other purposes (estimate 30,600 $m^3 y^{-1}$).

21 The annual requirement for freshwater for a UK EPR is likely to be 331,600 m^3. This could be from a mains water supply. EDF and AREVA mention using a desalination unit or abstraction from surface water sources such as a river or groundwater depending upon site characteristics. If the site needs abstracted surface water or groundwater, then the operator will need to obtain an abstraction licence from us before any abstraction takes place (if the daily abstraction volume exceeds 20 m^3). If the site needs a temporary or permanent reservoir for water then an impoundment licence may be needed from us.

22 In PCERsc12.2s2.3.2, EDF and AREVA state that following the selection of a suitable site an assessment of water resource availability would be undertaken. Only then can the question of how freshwater could be sustainably sourced would be addressed.

23 Consequently we accept that provision of freshwater will be a site specific matter and is outside the scope of GDA.

2.3.2 Seawater

24 The generic site for the UK EPR is a coastal or estuarine site. EDF and AREVA consider this as being representative of the development of potential nuclear power stations in the UK (PCERsc3.1 Introduction).

25 EDF and AREVA have only considered direct (also known as open, or once-through) seawater cooling of the steam turbine condensers and plant auxiliary systems. Although not explicit in our P&I Document we have considered whether the choice of cooling regime is broadly consistent with current best practice.

26 We recently commissioned a report entitled *Cooling Water Options for the New Generation of Nuclear Power Stations in the UK* (Environment Agency, 2010a). The purpose of the document was to "*investigate the potential cooling water options for new reactors and evaluate the environmental impact of these in terms of thermal, chemical and radionuclide pollution, and impact on biota*" to assist the UK regulatory authorities (the Environment Agency and the ONR[1]) in the GDA process. With regard to cooling, the report concludes that direct cooling "*can be the most appropriate environmental option for large power stations sited on the coast or estuaries, subject to current best planning, design and operational practice and best available mitigations being put in place, and meeting conservation objectives of the*

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[1] The Office for Nuclear Regulation (ONR) was created on 1st April 2011 as an Agency of the Health and Safety Executive (HSE). It was formed from HSE's Nuclear Directorate and has the same role. In this report we therefore generally use the term "ONR", except where we refer back to documents or actions that originated when it was still HSE's Nuclear Directorate.

site in question." Based on this conclusion we have accepted that the selection of direct cooling for the UK EPR is consistent with current best practice.

27 The National Policy Statement for Nuclear Power Generation (DECC, 2011) states at section 3.7.7: '*Applicants will be expected to demonstrate Best Available Techniques to minimise the impacts of cooling water discharges*'.

28 EDF and AREVA estimate that, allowing for a temperature increase (above inlet) of 12°C at the discharge point, the required flow rate of seawater for cooling will be 67 $m^3 s^{-1}$. They state that the optimum design flow rate must be large enough to cool the secondary water at the steam turbine condenser, but must also be such that the temperature increase at the discharge point is environmentally acceptable. Using a flow rate of 67 $m^3 s^{-1}$ means that the total annual volume of seawater required will be around 2.1 billion cubic metres.

29 If a desalination unit were used to supply freshwater, see above, an additional annual volume of 680,000 m^3 seawater would be needed.

30 We will have to decide at the site specific stage whether an abstraction licence is required for the seawater cooling supply. The abstraction of water from the open sea would not normally require an abstraction licence from us, unless the particular location of the abstraction or method of abstraction means that it falls within an inland water.

31 Historically, under the Water Resources Act 1963 [WRA63] the seaward boundaries for water abstraction licensing were generally taken as the low water mark (of ordinary spring tides) on the coast of the area, or at such point(s) where Local Orders made provision for more useful seaward boundaries to be defined. The subsequent Water Acts of 1973 and 1989 respectively, repealed these provisions.

32 Today, the main legislation for abstraction licensing is the Water Resources Act 1991 (as amended by the Environment Act 1995) and the Water Act 2003. Currently there is no specifically defined seaward boundary of jurisdiction for water resources and generally, the requirement for an abstraction licence is based on whether the water being abstracted is located within what is termed a "*Source of Supply*". By definition, Source of Supply includes any channel, creek, bay, estuary or arm of the sea, and is synonymous with inland waters, as opposed to the open sea.

33 We have assumed for GDA that the cooling water intake will be located in the open sea and that the abstraction will not be licensable. However, we will need to examine carefully the location of the abstraction for each specific site to decide whether an abstraction license is required. Future operators will need to contact us for advice giving full details of their proposals.

34 The abstracted seawater will need to be filtered to remove debris, including seaweed before it is used. EDF and AREVA describe using pre-filters followed by drum and chain filters (PCERsc3.4s3.2.1). Handling the removed material will need to be considered for each site, it will be a waste for disposal. In some cases, it can be macerated and returned to the sea. The operator for each specific site will need to discuss with us the need for waste or water discharge permits for the option chosen for the site. We have not assessed this matter at GDA.

2.3.3 Environmental impact of abstractions

35 EDF and AREVA set out the basis for their generic impact assessment for the UK EPR in the wider sense in PCERsc9.1. Their subsequent assessment, due to its generic nature, only gives a general overview of the potential impact associated with the water abstracted for use in the UK EPR. Generic impacts have been identified; methodologies used to assess these impacts where possible (using parameters characteristic of UK conditions) have been described; mitigation measures proposed; and limitations at GDA highlighted. The information and

parameters required to undertake a full impact assessment at the site specific stage are also described.

36 The primary concern with water abstractions is the potential impact upon marine organisms (ranging from planktonic bacteria and algae to macroinvertebrates and fish) of the seawater cooling intake. The design of this structure is critical to ensure that possible damage through entrapment, impingement and entrainment on filter screens, is minimised. Our Science report entitled "*Cooling Water Options for the New Generation of Nuclear Power Stations in the UK*" (Environment Agency, 2010a) explains the matters surrounding intake design and reviews mitigation measures. We would expect operators to contact us at the early stages of site specific designs so that we can advise on techniques to minimise the impact of cooling water intakes on marine ecology.

37 We will assess and comment on the proposed intake design in our role as statutory consultee in the planning process. If the abstraction were licensable (under the Water Resources Act 1991) then we would also seek to influence the design through agreed conditions on the abstraction licence, for example, requiring the operator to install mitigation measures and / or undertake monitoring programmes.

38 While EDF and AREVA's generic impact assessment is useful insofar as it demonstrates an awareness of the relevant matters, the results are inconclusive due to the generic nature of the assessment, particularly with respect to ecology. EDF and AREVA have identified the considerable limitations for this work under GDA and point towards the need for site specific work to properly assess ecological impacts. This is consistent with our understanding of the requirements of the Environmental Impact Assessment (EIA) process.

2.4 Conclusion

39 EDF and AREVA propose abstraction of cooling water from the open sea, as direct seawater cooling is the preferred means for cooling the steam turbine condensers and plant auxiliary systems. Abstraction from the open sea would not require an abstraction licence from us.

40 There are a number of matters that are outside the scope of GDA and which will need to be addressed by future operators at the site specific stage, namely:

a) the design of the seawater intake such that it will minimise damage to marine life;

b) the provision of freshwater for plant process and sanitation needs, etc, including consideration of the need for a desalination plant;

c) the ecological impact assessment of freshwater and seawater abstractions; and

d) the management of marine debris from the seawater intake filters.

3 Environmental Permitting Regulations 2010 (EPR 10): Discharges to surface water

41 The Environmental Permitting Regulations (England and Wales) 2010 (EPR 10), cover water discharges and groundwater activities, radioactive substances, waste, mining waste and specified installations.

42 You can find more information on EPR 10 on our website: Environment Agency - Environmental permitting. Also guidance is available on discharges to water: Environment Agency - Environmental permitting guidance - point source discharges to surface water or groundwater.

3.1 Assessment Objectives

43 We started our assessment with some key questions to answer:

a) what is the role of BAT within this assessment and with respect to our established Water Quality permitting process?

b) what do we see as being the potential constraints involved with assessing discharges to controlled waters at a generic level;

c) what subject areas can only be assessed properly when you are dealing with a specific location?

d) have EDF and AREVA provided enough information for us to fully characterise the UK EPR's liquid process streams?

e) based on the information available at GDA could we make an in principal decision on the likelihood of granting a discharge permit for the UK EPR design at the site specific stage; and

f) dependent upon the constraints identified, how do we ensure that we produce a meaningful assessment at GDA, while being reasoned and pragmatic about the potential future site specific work?

3.2 Consideration of BAT

44 Best available techniques (BAT), is defined under the OSPAR Convention[2] and European Directive 1996/61/EC on Integrated Pollution Prevention and Control (IPPC) (EC, 1996) as "*the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste*". We have considered in GDA whether the UK EPR design uses BAT to prevent and, where prevention is not practicable, minimise:

a) the production and discharges of non-radioactive substances (including heat); and

b) land contamination and groundwater pollution by non-radioactive substances;

both during routine operations and from abnormal events.

45 When we review permits for existing discharges or issue permits for new ones our aim is to issue permits that prevent or minimise any deterioration in the quality of water bodies that could otherwise occur as a result of the discharge. We refer to this as '*no deterioration*' and our ideal is for no increase in the planned pollutant load discharged to the water body, although in most cases there is some degree of 'acceptable' deterioration. The '*no deterioration*' policy does not have BAT as the criteria for acceptability but instead aims to balance deterioration against cost and

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[2] Convention for the Protection of the Marine Environment of the North-East Atlantic, 1992 ("OSPAR Convention")

practicality. If the discharge were to threaten a Water Quality standard, only then would BAT become a relevant criteria. This would normally lead to controls and limits tighter than those based on considerations of environmental impact only.

46 If we have to consider BAT it is recognised that a point can be reached where the additional costs of securing further reductions in discharge quantity and / or quality, and of the risks associated with those discharges, would far outweigh the increased protection arising from such improvements to the environment and / or the general public. However, where a statutory obligation, for example, an EQS, requires stricter conditions and quality limits than those achievable by the use of BAT then we would seek to ensure that:

a) the operator investigates whether alternative means exist, for example, a change in process or equipment, or a change in operational regime; and / or

b) additional regulatory measures or controls are applied as necessary;

c) compliance with said discharge quality limits can be achieved.

47 The National Policy Statement for Nuclear Power Generation (DECC, 2011) states at section 3.7.7: '*Applicants will be expected to demonstrate Best Available Techniques to minimise the impacts of cooling water discharges*'.

3.3 EDF and AREVA documentation

48 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
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UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03
UKEPR-0003-062	PCER – Sub-chapter 6.2 – Details of the effluent management process	04
UKEPR-0003-063	PCER – Sub-chapter 6.3 – Outputs for the Operating Installation	04
UKEPR-0003-064	PCER – Sub-chapter 6.4 - Effluent and waste treatment systems design architecture	04
UKEPR-0003-070	PCER – Chapter 7 – Measures for monitoring discharges	01
UKEPR-0003-080	PCER – Chapter 8 – Best Available Techniques	02
UKEPR-0003-090	PCER – Chapter 9 – Principles and methods used for environmental approach at the design stage	02
UKEPR-0003-120	PCER – Chapter 12 – Non radiological impact assessment	02
UKEPR-0007-001	Monitoring of liquid and gaseous discharges: Prospective arrangements for the UK EPR	02

49 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

3.4 Assessment

3.4.1 Generation of liquid effluents

50 EDF and AREVA say that the UK EPR will generate liquid effluents of two types (PCERsc3.4s5.1):

a) radioactive liquid effluent associated with the reactor coolant. The radioactivity of this effluent is dealt with in our report EAGDAR UK EPR-05 (Environment Agency, 2011b) but the effluent will also contain chemicals and metals, e.g. corrosion products, that will need to be covered in a discharge permit from us and which therefore merit consideration here; and

b) non-radioactive liquid effluent coming from conventional parts of the UK EPR such as the demineralisation plant, the desalination plant (if applicable), seawater chlorination facility, turbine hall drains and the site sewage treatment facilities.

3.4.1.1 Radioactive liquid effluent

51 The main chemicals used in the UK EPR and associated with the liquid radioactive effluent are (PCERsc3.4s5.3.1):

a) boric acid added to the coolant as a neutron absorber;

b) lithium hydroxide added to the coolant to offset the acidity of the boric acid to prevent equipment corrosion;

c) hydrazine used as an oxygen scavenger in the feedwater;

d) ammonia, morpholine and ethanolamine to adjust pH of secondary circuit water to minimise corrosion;

e) trisodium phosphate used in some auxiliary cooling and heating circuits as a corrosion inhibitor;

f) detergents used in the laundry to clean work clothes.

52 EDF and AREVA predict the annual discharges of chemicals associated with radioactive effluent to be (PCERsc3.4 Table 3):

Chemical	Expected discharge without contingency (kg)	Maximum annual discharge (kg)
Boric acid (boron, our estimate)	2,000 (350)	7,000 (1,224)
Lithium hydroxide	< 1	4.4
Hydrazine	7	14
Morpholine	345	840
Ethanolamine	250	460
Nitrogen compounds (as N) excluding hydrazine, morpholine and ethanolamine	2,350	5,060
Phosphate	155	400
Detergents	630	1,600
Metals	16	27.5
Suspended solids	655	1,400
Chemical oxygen demand (COD)	1,490	2,525

53 Metals will arise from corrosion and erosion in the circuits where coolant and other process waters contacts equipment. Metals used in the UK EPR equipment include aluminium (Al), copper (Cu), chromium (Cr), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb) and zinc (Zn). The UK EPR uses chemical controls to minimise corrosion. Effluents are filtered and, in the case of effluent from treating coolant, passed through ion exchange resins. These techniques will minimise the quantities of metals present in discharges.

54 Based on similar PWR plants, EDF and AREVA predict that the distribution of metals in the radioactive liquid effluent storage tanks (see section 3.4.2.1 below) is as follows, (PCERsc3.4 Table 5):

Al	Cu	Cr	Fe	Mn	Ni	Pb	Zn
8.95%	0.7%	14.1%	59.3%	5.6%	0.75%	0.5%	10.1%

55 In addition to the metals listed above EDF and AREVA state that traces of mercury, cadmium and arsenic can be present in bulk raw materials (PCERsc12.2s2.5.3.2) but they have not provided estimates of these discharges at GDA. They state this is because no monitoring has taken place in France, where the discharge of such substances is not subject to consent when they result from impurities contained in chemicals used for conditioning processes. EDF and AREVA have established specifications for levels of mercury and lead in conditioning products, and have prohibited the use of cadmium and arsenic as basic product components in the reactor water.

56 It is likely that the presence of these impurities in the discharge will be at low concentrations, possibly trace amounts following filtering and ion exchange

treatment. More detailed information will be required for a site specific application for a discharge permit.

57 EDF and AREVA also state in PCERsc12.2s2.5.3.3 that silver can arise in trace amounts from corrosion of control rods although it is not likely to be found as in impurity within bulk raw materials.

58 Suspended solids may come from dust in drain effluents or from raw water used in some auxiliary circuits.

59 Chemical oxygen demand (COD) will arise from detergents and other organic chemicals used such as morpholine and ethanolamine.

3.4.1.2 Non-radioactive liquid effluent

60 The main substances associated with the non-radioactive liquid effluent from the UK EPR are (PCERsc3.4s5.4.1):

a) iron, predominantly introduced as ferric chloride into the demineralisation or desalination plant;

b) suspended solids, present in the slurry and filter backwashings from the demineralisation plant;

c) sulphates, predominantly introduced when resins are regenerated with sulphuric acid in the demineralisation or desalination plant;

d) sodium, introduced in one of three forms, i.e. sodium hypochlorite, sodium hydroxide or sodium metabisulphite, for various processes in the demineralisation or desalination plant;

e) chlorides, introduced as ferric chloride or sodium hypochlorite in the demineralisation or desalination plant; and used for cleaning of the seawater chlorination equipment;

f) dispersants, introduced to prevent precipitation of calcium compounds in the desalination plant;

g) detergents, used to clean membranes in the desalination plant;

h) brine, from seawater;

i) residual oxidants and trihalomethanes (bromoform), introduced as a result of the seawater chlorination process; and

j) effluent from the on site sewage system.

61 EDF and AREVA say that demineralised water needed for use in the UK EPR will be produced by a demineralising plant using a fresh water supply or a desalination plant. Both plants would produce effluent and, as an example for GDA, they have predicted the annual amount of substance produced based on 40 days use of a demineralisation plant and the rest of time by a desalination plant (as foreseen for the reference EPR at Flamanville 3) (PCERsc3.4s5.4.1.1). The exact nature of the water production regime for a UK EPR will be a site specific matter.

62 EDF and AREVA predict the annual discharges of chemicals associated with non-radioactive liquid effluent to be (PCERsc3.4s Table 6):

Substance	Annual discharge (kg)
Suspended solids	1,621
Iron	848
Chlorides	3,616
Sulphates	11,725
Sodium	13,523
Detergents	312

63 EDF and AREVA have provided some information on trace metal contamination of raw materials such as sodium hydroxide and sulphuric acid used in the demineralisation process (TQ-EPR-227). Contamination usually includes cadmium and mercury which are Dangerous Substances (as defined under the Dangerous Substances Directive). However, it is likely that their presence in the discharge will be at low concentrations, possibly trace amounts. More detailed information will be required for a site specific application for a water discharge permit.

64 Seawater cooling circuits need to be protected from biological fouling when the seawater inlet temperature is above 10°C. The UK EPR will use an electrolysis system to produce sodium hypochlorite within the seawater. The system will leave residual oxidants and bromoform in the returning seawater. (PCERsc3.4s5.4.3.3)

65 The electrochlorination process is site-specific and depends on local water quality. However, EDF and AREVA have provided some predictions of discharge concentrations for residual oxidants and bromoform under different treatment scenarios. Increased dosing levels (above normal) will be necessary where changes in water quality cause excessive biofouling (exceptional chlorination), or where it is necessary to treat those parts of the circuits which are particularly prone to biofouling (shock chlorination).

66 EDF and AREVA predict the following maximum discharge concentrations associated with the seawater chlorination process (PCERsc3.4s5.4.3.3 Table 8):

Chlorination regime / dose rate	Maximum concentration in discharge pool (mg l^{-1})	
	Residual oxidants	Bromoform
Normal / 0.5 mg l^{-1}	0.5	0.02
Exceptional / 1 mg l^{-1}	1	0.04
Shock / 6 mg l^{-1}	0.72	0.0244

67 EDF and AREVA have provided an estimate of the impact from the electrochlorination process, quantifying the likely concentrations of TRO (Total Residual Oxidant) against its respective EQS - see the table later in this report (PCERsc12.2 Table 5). While they conclude that the area of water exposed to TRO concentrations which exceed the EQS is likely to be limited to the immediate vicinity of the discharge point, they confirm that this is a highly site-specific assessment area. This is consistent with our understanding and is consequently why we have

not assessed this issue at GDA. Future work involving using local water quality information and dispersion modelling would be necessary to support a site-specific application for a discharge permit.

68 The site of a UK EPR will need a sewage system to collect (and treat where necessary) rainwater, wastewater from washroom facilities and lavatories, water drainage that might contain oil and demineralisation or desalination plant effluent. EDF and AREVA state that typical concentrations levels for BOD (biochemical oxygen demand) and hydrocarbons in the sewage effluent will be < 35 mg l^{-1} and < 5 mg l^{-1} respectively (PCERsc3.4s5.4.3.2.).

3.4.2 Treatment and discharge of liquid effluents

69 It is expected that EDF and AREVA will utilise the cooling water return flow where possible to further dilute liquid effluents prior to discharge to sea. While the PCER states that liquid radioactive effluents will be discharged via the discharge pond, which also receives the cooling water return flow, the discharge route for non-radioactive liquid effluents is not specifically defined for a UK EPR (see below).

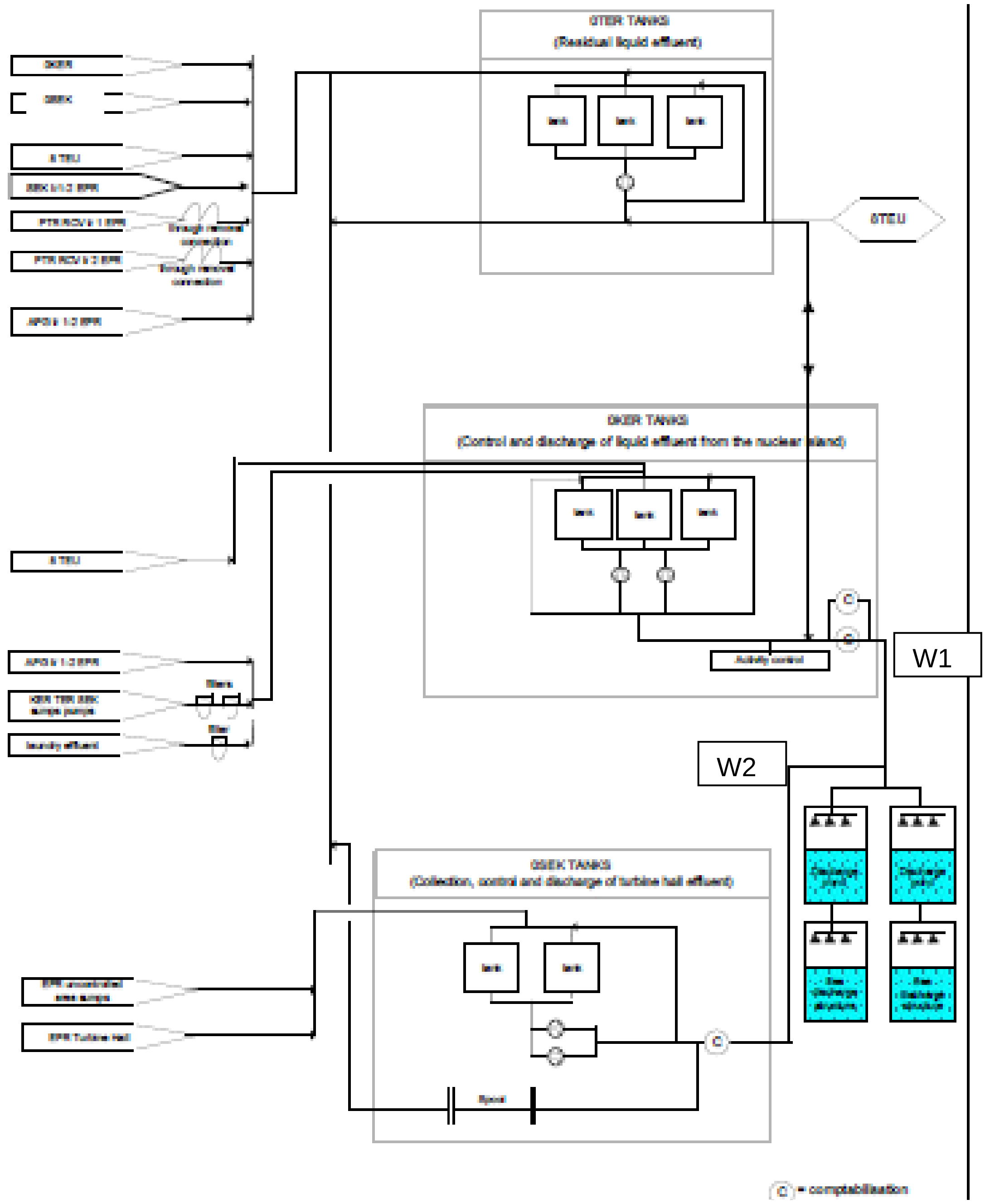
70 Our previously mentioned Science Report on cooling water options (Environment Agency, 2010b) acknowledges that it is not uncommon for power stations to "*make use of the cooling system for rapid dilution of low level radioactive waste and sewage treatment plant / 'grey' water*", even though best practice would suggest that wastewater should be kept separate from the cooling system. We accept that the typically massive dilutions offered by discharging power station effluents into the cooling water return flow can considerably reduce the concentration of most substances to environmentally acceptable levels without the need for additional treatment, thus making it an attractive option for designers and operators.

3.4.2.1 Radioactive liquid effluent

71 A variety of processes are employed in the UK EPR for the treatment of radioactive liquid effluent, e.g. filtration, demineralisation, evaporation, degassing (PCERsc3.4s5.2.2). Treated radioactive effluent will then be collected in the Liquid Radwaste Monitoring and Discharge System (LRMDS) storage tanks or Residual Liquid Effluent System (exLWDS) storage tanks. The LRMDS tanks receive non-recyclable effluents from the primary and secondary circuits. The exLWDS tanks are extra storage tanks for contingency. The SiteLWDS tanks receive effluents from the turbine hall and non-active pumps, these effluents are uncontaminated with radioactivity in normal operation but may show low levels of tritium in the event of any leaks from the primary to the secondary systems. After sampling and analysis the contents of the tanks may be authorised for discharge under an internal management procedure.

72 The discharge of liquid radioactive effluent will be through discharge points W1 and W2 to join the cooling water return flow at the discharge pond, for onward discharge to sea via the discharge tunnel, see figure below from PCERsc6.4s2.3 Figure 1 (page 86):

SECTION 6.4.2.3 - FIGURE 1: OVERALL 0KER [LRMDS]-0SEK [SiteLWDS]-0TER [ExLWDS] DIAGRAM Available for FA3



3.4.2.2 Non-radioactive liquid effluent

73 The treatment of non-radioactive liquid effluents within the UK EPR is not specifically defined at the GDA stage. We note that there is the potential for some effluent streams to receive no further treatment than dilution within the cooling water return flow, which may be acceptable due to the limited impact of the substances contained within the streams.

74 The design of the sewage system itself (incorporating purification stations and/or standalone treatment facilities) will be site specific and therefore has not been assessed under GDA. We note that EDF and AREVA have identified that oil traps and a retention area (to collect fire water or accidentally polluted water) will be

needed in such a system and we confirm that we will require these techniques. The operator will need to provide details and justification of the site specific design in an application for a water discharge permit. (PCERsc3.4s5.4.1.4/5)

75 The discharge arrangements for non-radioactive liquid effluents are not defined at GDA. EDF and AREVA have submitted for comparison the arrangements for their Flamanville 3 site in France (PCER sc3.4s5.4.2). The operator of a specific site will need to define all points of discharge, giving amongst other information, flows and the expected composition and concentrations of effluents at each point, in order to characterise all effluent streams.

3.4.3 Effluent monitoring

76 EDF and AREVA have presented details on the effluent monitoring regime prior to discharge that could be implemented in the UK EPR by describing the arrangements already in place on existing French and German reactors (PCERsc7 and UKEPR-0007-001).

77 Effluent flow measurement and sampling for a site specific UK EPR will need to be MCERTS compliant. MCERTS is the Environment Agency's monitoring certification scheme established to deliver quality environmental measurements. It is based on international standards and provides for the product certification of instruments, the competency certification of personnel and the accreditation of laboratories. MCERTS provides the framework for operators to meet our quality requirements.

78 We anticipate that the flow measurement and sampling equipment at W1 and W2 specified for radioactivity discharge monitoring will also be used for chemicals and metals monitoring, as required under MCERTS. However, the exact location of the sampling points, the number of sampling points and the parameters to be sampled at each point will be a site specific matter to be agreed with the operator.

3.4.4 Environmental impact of non-radioactive liquid discharges

79 The key matters for assessing non-radioactive discharges to controlled waters are the discharge of certain Dangerous Substances and the discharge of thermally adjusted cooling waters. Both these matters would be subject to control by an Environmental Permit from the Environment Agency.

3.4.4.1 Chemicals, including Dangerous Substances

80 Dangerous substances (as specified under the Dangerous Substances Directive) and priority substances and priority hazardous substances (as specified under the Priority Substances Directive) are toxic and pose the greatest threat to the environment and human health. The Directives require that we either eliminate or minimise pollution by these substances. We define pollution by dangerous substances / priority substances as exceeding environmental quality standards (EQSs) in the water. The EQS defines a concentration in the water below which we are confident that the substance will not have a polluting effect or cause harm to plants and animals.

81 The requirements of the Dangerous Substances Directive are now integrated in the Water Framework Directive, and the Dangerous Substances Directive will be fully repealed in 2013. The Priority Substances Directive now applies to discharges of priority substances and sets EQSs for priority and priority hazardous substances. The Water Framework Directive is designed to improve and integrate the way water bodies are managed throughout Europe. Member states must aim to reach good chemical and ecological status in inland and coastal waters by 2015. This overarching piece of legislation will have wide implications for any new nuclear power station built in Europe, not least because EQS compliance serves as a key indicator of both chemical and ecological status.

82 EDF and AREVA have provided an impact assessment for some of the substances discharged to sea from a UK EPR, some of which are Dangerous Substances under the Directive. This follows the principles of the Agency's H1 guidance (modified slightly to better reflect the discharge of substantial plumes to the marine environment) (Environment Agency, 2010c). H1 is used for assessing the risks to the environment and human health from facilities which are applying for a permit under the Environmental Permitting Regulations. Insignificant risks are screened out and more detailed assessment is only needed where the risks justify it.

83 EDF and AREVA have assessed those substances which currently have an EQS. They include (a) metals contained in the radioactive liquid effluent and non-radioactive demineralisation plant effluent; and (b) other circuit conditioning chemicals (PCERsc12.2s2.5.1). The assessment of metals takes into account the corrosion (and erosion) products arising in both the primary and secondary circuits and which are collected in the LRMDS and SiteLWDS tanks. From PCERsc12.2 Table 5:

Substance	**Annual discharge (kg)**	**Discharge concentration ($\mu g\ l^{-1}$)(DC)**	**Environmental quality standard ($\mu g\ l^{-1}$)(EQS)**	**DC/EQS (%)**
Ammonia unionised (as N)	167	0.08	21 (our proposed EAL)	0.4
Boron	1224	0.58	7,000	0.008
Iron	864	0.41	1,000	0.04
Copper	0.19	0.0001	5	0.002
Nickel	0.21	0.0001	30	0.0003
Chromium	3.88	0.002	15	0.0122
Zinc	2.78	0.0013	40	0.0033
Lead	0.14	0.00007	25	0.0003
TRO (Total Residual Oxidant)	-	500	10	5000

Notes: EDF and AREVA conclude that the area of water exposed to TRO concentrations which exceed the EQS is likely to be limited to the immediate vicinity of the discharge point. As the fate of chlorine in seawater is a highly complex issue further site specific studies will be required in this area.

84 The discharge concentration (DC) is that at the final discharge point to the sea after the effluent has been diluted with 67 $m^3 s^{-1}$ of returning cooling seawater.

85 The discharge concentrations of all metals assessed are well below 1% of their EQS. We do not consider substances with discharge concentrations at less than 1% of the EQS to be significant and therefore do not require detailed dispersion modelling or further impact assessment.

86 Our procedures for permitting dangerous and priority substances to coastal waters are based on the relationship between the discharge concentration and the EQS. We apply a staged approach which involves more rigorous assessment as each

stage is passed. The rigour of each stage is reflected in the need for increasing levels of site specific information and possibly dispersion modelling studies.

87 If the discharge concentration of a substance is less than the EQS then it is considered insignificant. At the other end of the scale, we may have to define what is an acceptable *mixing zone* for a particular substance, taking account of local constraints such as sensitive ecological areas and specify appropriate limits for that substance in a water discharge permit.

88 The discharge concentrations for dangerous and priority substances estimated by EDF and AREVA suggest that in terms of our assessment, these concentrations are not significant. More detailed information would be required in support of a site specific permit application, to include amongst other information details on those metals not considered so far, for example aluminium, manganese and more harmful substances such as cadmium and mercury.

89 EDF and AREVA have not undertaken an impact assessment for those substances used as circuit conditioners (both primary and secondary circuits) which do not have an EQS. These substances require further assessment and may potentially be subject to control on a discharge permit. The operator will need to expand on this topic and provide additional information on the impact of these substances in support of a site specific application for a discharge permit. Circuit conditioning products should however breakdown readily upon dilution with the cooling water return and upon mixing within the marine environment.

3.4.4.2 Thermal discharge

90 The primary environmental effects of power station thermal discharges relate to temperature rise and cooling water system biocide residues.

3.4.4.2.1 Temperature rise

91 Heat is defined as pollution under the Water Framework Directive. Under the Directive draft temperature standards have been published based on the requirements for transitional and coastal waters of Good Ecological Status. In common with other directly cooled power stations (both conventional and nuclear), the UK EPR will produce and discharge large volumes of thermally adjusted cooling waters.

92 EDF and AREVA have provided a summary of the results from their thermal impact study for the Flamanville 3 site (PCERsc12.2 Appendix). While it highlights their basic approach to modelling of the thermal plume, the conclusions are meaningless for a UK site (or any other site for that matter) due to the highly localised nature of the study.

93 EDF and AREVA acknowledge that the thermal impact of the returning cooling seawater (67 $m^3 s^{-1}$ at 12°C above the inlet water temperature) can only be modelled on a site specific basis (PCERsc12.2s2.4). This is consistent with our understanding and therefore we have not assessed potential thermal impact under GDA. Due to the highly localised data requirements of dispersion modelling a detailed study will be required for a site specific application for a water discharge permit.

3.4.4.2.2 Cooling water system biocide (anti-fouling) residues

94 EDF and AREVA have provided an estimate of the impact from the seawater chlorination process, quantifying the likely concentrations of TRO (Total Residual Oxidant) against its respective EQS (PCERsc12.2s2.5.3.1). While they conclude that the area of water exposed to TRO concentrations which exceed the EQS would probably be limited to the immediate vicinity of the discharge point, they confirm that this is a highly site specific assessment area. This is consistent with our understanding and is consequently why we have not assessed this matter at GDA.

Future work involving the use of local water quality information and dispersion modelling would be necessary to support a site specific application for a discharge permit.

3.4.4.3 Ecological impacts

95 As mentioned previously (s3.4.4.1 above), EDF and AREVA have undertaken an ecological impact assessment based on a representative UK site (PCERsc12.3s3.2). While this is useful insofar as it demonstrates an awareness of the relevant issues, identifying potential impacts and mitigation measures, the results are inconclusive due to the generic nature of the assessment, particularly with respect to ecology. For example (and to highlight this point), at GDA it is not possible to assess the UK EPR discharge under the Habitats Directive.

96 The Habitats Directive created a network of protected areas around the European Union called 'Natura 2000' sites. These sites are found in abundance at various locations around the UK's coastline and could potentially be affected by new nuclear power station discharges. However, to determine whether a discharge is "relevant" under the legislation we would need to pinpoint it to a particular location. If the discharge were "relevant" we would apply increasingly rigorous assessment stages, ultimately requiring site specific knowledge about how a discharge plume would behave in the receiving water. Detailed dispersion modelling could be required and this is outside the scope of GDA.

97 EDF and AREVA have identified the considerable limitations for assessing ecological impacts at GDA and point towards the need for further site specific work. This is consistent with our understanding and is consequently why we have not assessed this matter at GDA.

3.4.5 Consideration of BAT for the production and discharge of non-radioactive liquid effluent

98 EDF and AREVA set out their approach with respect to BAT in PCER Chapter 8. It is based around the 4 key BAT policy objectives as set out in the IPPC Directive (EC, 1996), namely:

a) the use of low waste technology;

b) the efficient use of resources;

c) the prevention and reduction of the environmental impact of emissions; and

d) the use of less hazardous substances.

99 PCERsc8.1s4 states that there are 15 optimisation factors for nuclear installations that underpin the 4 BAT policy objectives above. In simple terms EDF and AREVA have made the case for BAT based on how compliant a particular process, technique or system is against these optimisation factors.

100 With regard to liquid effluents the PCER deals predominantly with BAT for radioactive liquid effluents, but the principles could apply equally to non-radioactive effluents, i.e.

a) reduce the production of effluents at sources;

b) design optimum effluent treatment and sorting systems; and

c) design storage systems suitable for the site.

101 The following PCER sections demonstrate that the application of BAT principles are key to the UK EPR design philosophy:

102 PCERsc8.2s3.3.3.1 describes how the design and operation of the various filtration techniques achieves 3 of the BAT policy objectives and their associated optimisation factors.

103 PCERsc8.2s3.3.3.2 describes how the design and operation of the various demineralising techniques achieves 3 of the BAT policy objectives and their associated optimisation factors.

104 PCERsc8.2s5 describes how the design of the seawater cooling intake and discharge structures will be designed to achieve 2 of the BAT policy objectives and their associated optimisation factors.

105 PCERsc8.2s6 describes how by reducing the amount of freshwater consumed by the plant all 4 of the BAT policy objectives could be achieved.

106 We therefore accept that on the whole EDF and AREVA have considered and demonstrated at a generic level how BAT has been applied to prevent and minimise the production of non-radioactive effluents. The site specific aspects of BAT will need to be covered by future operators.

107 More information on the seawater chlorination process would have proved useful – that is, how the cooling water system has been optimised to minimise the need for the use of anti-fouling agents. This needs to be explored further by EDF and AREVA.

3.5 Conclusion

108 We concluded for water discharges that:

a) the predicted discharges of non-radioactive substances from a UK EPR are less than one per cent of any environmental quality standard at the point of disposal to the sea with the exception of biocide used to control fouling, however additional breakdown in the mixing zone around the outlet would be expected to meet the relevant standard, and therefore should be compatible with the Water Framework Directive aim of achieving good ecological and chemical status in the receiving water; and

b) we should be able to permit the discharges of non-radioactive substances to water from a UK EPR under EPR 10. However, this will depend on our determination of site-specific applications and any application for a permit will need to provide a detailed environmental impact assessment based on dispersion modelling.

c) There are a number of site specific matters that are outside the scope of GDA and which will need to be addressed by potential operators at site specific permitting, namely:

i) the impact of the thermal plume (heat) on the receiving environment;

ii) the impact of biocide residues on the receiving environment;

iii) the consideration of the ecological impacts of the discharge(s), including assessment under the Habitats Directive where applicable;

iv) the impact assessment of those substances and metals currently without an EQS, in particular circuit conditioning chemicals;

v) the full consideration of trace metal contained within bulk raw materials;

vi) the discharge arrangements for non-radioactive effluent streams;

vii) the design of the on site sewage system; and

viii) the exact nature of the effluent monitoring regime.

4 Environmental Permitting regulations 2010 (EPR 10): Discharges to groundwater

109 This topic is mainly about preventing any non-radioactive contaminants in liquid streams in the UK EPR from:

a) directly contaminating groundwater; or

b) contaminating land that will then lead indirectly to contamination of groundwater.

Groundwater is vulnerable to contamination and difficult to clean if contamination occurs. It is intimately linked to both surface water and soils, so substances can get into groundwater from either.

110 A permit is required from us for the deliberate discharge of certain substances, to groundwater, with the aim of preventing or limiting pollution of groundwater (Environmental Permitting Regulations 2010 (EPR 10)). You can find more information on EPR 10 on our website: Environment Agency - Environmental permitting. Also guidance is available on groundwater: Environment Agency - Environmental permitting guidance - groundwater

4.1 Assessment Objectives

111 Our assessment was aimed at:

a) Deciding whether a UK EPR might need an EPR 10 permit for discharges to groundwater.

b) Deciding whether pollution prevention techniques used in the UK EPR were adequate to prevent any accidental leaks or spills entering groundwater.

4.2 EDF and AREVA documentation

112 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER-Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03

113 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

4.3 Assessment

114 EDF and AREVA claim that there is no likelihood of direct or indirect discharges of relevant substances to groundwater from the UK EPR. In that case, a UK EPR should not need to be permitted by us for a discharge to groundwater under EPR 10.

115 EDF and AREVA list the following substances relevant to groundwater pollution as liable to be on a UK EPR site (PCERsc12.2s2.2):

a) hazardous substances: hydrazine hydrate, bromoform, hydrocarbons and radioactive substances;

b) non-hazardous pollutants: metals, phosphates, ammonia and nitrates.

116 Diesel fuel (a hydrocarbon) used by the UK EPR stand-by generators will present a potential risk to groundwater. However, its use will be within a permit from us, see section 5 below, and we will ensure through that permit that BAT are used to prevent any discharge to groundwater.

117 EDF and AREVA claim that any other '*storage tanks, chemical stores, refuelling areas and other activities that have the potential to pollute the environment will be placed on hard surfaces or bunded to contain spills*'. We will inspect facilities on specific sites during construction to confirm that appropriate prevention measures are in place before operations commence. (PCERsc12.2s2.2)

118 EDF and AREVA identify that the operator of a UK EPR site will need to have emergency procedures to be implemented in the case of any accidental spillage. The procedures should ensure that sources of contamination are found quickly and that the sources and any contaminated soil are treated to protect groundwater from pollution. We confirm that we expect operators to have such procedures in place before operations commence.

119 EDF and AREVA state that groundwater monitoring boreholes will be established during the construction of a UK EPR. These will remain in place during operation and should detect any contaminants that reach groundwater inadvertently. (PCERsc8.3s3.1) We confirm this is good practice and will work with operators to establish an effective network of boreholes and an appropriate monitoring programme.

4.4 Conclusion

120 We conclude that:

a) the site of a UK EPR should not need to be permitted by us for a discharge to groundwater under the Environmental Permitting Regulations 2010;

b) pollution prevention techniques used in the UK EPR are adequate to prevent any leaks or spills entering groundwater.

5 Environmental permitting regulations 2010 (EPR 10): Combustion plants

121 The Environmental Permitting Regulations (England and Wales) 2010 (EPR 10), cover water discharges and groundwater activities, radioactive substances, waste, mining waste and specified installations.

122 EPR 10 replaced the Pollution Prevention and Control Regulations (PPC) and requires operators of installations containing certain activities to apply for and obtain a permit from us before commencing operations. In relation to the UK EPR, combustion activities, where fuel is burned in two or more appliances with an aggregated rated thermal input of 50 MW or more, are relevant.

123 You can find more information on EPR 10 on our website: Environment Agency - Environmental permitting. Also guidance is available on combustion activities: Environment Agency - Permitting guidance for combustion activities.

5.1 Assessment Objectives

124 Our assessment was aimed at:

a) Deciding whether a UK EPR might need an EPR 10 permit for combustion activities.

b) If the UK EPR contained an EPR 10 combustion installation, whether we might permit such an installation.

5.2 EDF and AREVA documentation

125 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER-Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03
UKEPR-003-120	PCER – Chapter 12 – Non radiological impact assessment	02
UKEPR-0004-001	PPC Application – diesel generators	00

126 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

5.3 Assessment

127 The UK EPR will include 4 main emergency backup electricity generators (emergency diesel generator – EDG). Each will have a thermal input of 17.6 MW to generate 7.5 MW of electricity. There will also be 2 ultimate emergency backup generators (station black out – SBO), each of 6 MW input to generate 2.5 MWe. The total thermal input for the 6 diesels (compression ignition engines) will be 82.4 MW, therefore any Operator of a UK EPR will need to obtain a combustion activities permit from us. (PCERsc3.3s4.2.1.1)

128 The emergency generators are all nuclear safety equipment to provide backup power supplies in the unlikely event of loss of off-site supply or if UK EPR load operation fails. They will not normally operate except for periodic testing. EDF and AREVA claim that the estimated running time for testing of each diesel should be less than 20 hours in a year.

129 EDF and AREVA say that the choice of diesel generator suppliers will only be made at later stages of construction. Therefore, precise details of diesel performance and discharges can only be provided at the site-specific permitting stage. They have provided '*Generic information for UK EPR diesel generators*' in the supporting document UKEPR-0004-001. We have reviewed the document and have the following comments:

a) Site Report – this is a site-specific matter and cannot be assessed at GDA.

b) A technical description is provided: essentially there are two buildings each with two EDGs and one SBO, each EDG having a fuel oil storage tank of 180 m^3 capacity and each SBO having a fuel oil storage tank of 25 m^3 capacity. The operator will need to demonstrate that BAT are used for the design of the buildings and facility to prevent any leaks of oil reaching land or groundwater.

c) The main aerial emissions of concern are sulphur dioxide (SO_2) and oxides of nitrogen (NOx) in the waste combustion gases:

   i) minimisation of emissions of SO_2 will be by using low sulphur content fuel oil (current UK regulations limit sulphur content to 0.1 per cent by weight), we accept this as BAT;

   ii) minimisation of emissions of NOx will rely on engine design and will not be confirmed until a late stage of site-specific permitting. EDF and AREVA have quoted a typical discharge concentration of 2,542 mg m^{-3} NOx (as nitrogen dioxide, NO_2 at five per cent oxygen). The operator will need to provide a detailed BAT options appraisal with the permit application to show that the engine chosen minimises discharges of NOx. We believe that the concentration quoted as typical is high and that engines are currently available with much lower discharge concentrations of NOx. This is a technology area where improvements are taking place and we expect the Operator to review latest available equipment to identify BAT.

   iii) EDF and AREVA review abatement techniques for NOx (for example, selective catalytic reduction). It is likely that none will be BAT when the intermittent basis of operation (20 hrs y^{-1}) is considered. EDF and AREVA defer any decision on abatement until the site-specific stage, the Operator will need to provide evidence that abatement options have been considered in the application BAT assessment.

d) The Health Protection Agency (GDA88) reminded us that all pollutants not just SO_2 and NOx need to be considered. We will undertake a full assessment before issuing a permit. Carbon monoxide, particulates and volatile organic compounds (VOCs, in this case unburnt hydrocarbons) are among the pollutants that will be assessed.

e) The operator will need to show that there will be appropriate management systems in place for the installation. This is an operator and site-specific matter and is not assessed at GDA. EDF and AREVA suggest an environmental management system such as ISO14001:2004 would be appropriate and we agree with this suggestion.

f) Apart from fuel oil there will be few raw materials used – some lubricating oil and antifreeze – and little waste generated.

g) Cooling water for the engines will be in a sealed system, so there should be no liquid effluents to be disposed of to the sea.

h) The generators are essential for safety of the nuclear plant and, therefore, energy efficiency concerns are not appropriate. EDF and AREVA state that any electricity generated during tests would be exported to the grid together with the electricity generated by the UK EPR itself.

i) Noise from the operation of diesel generators can be an issue. EDF and AREVA say that as operation of the generators is intermittent so noise generated will also be intermittent. However, we believe intermittent noise can have its own issues and an operator will need to show procedures to minimise any impact. The operator will need to show that the design of the generator buildings and engine exhaust silencers are BAT to minimise impact of noise.

j) We are unlikely to require any continuous monitoring of emissions from the diesel engines or any environmental monitoring. Occasional testing of emissions by MCERTS portable equipment should be enough.

k) Diesel generators and their associated facilities should not be a significant matter at site closure.

l) EDF and AREVA expect the annual fuel usage to be 31 te for each EDG and 10.5 te for each SBO, a total of 145 te. On this fuel usage the annual emission of sulphur dioxide (at 0.1 per cent sulphur content) would be 290 kg. The annual NOx emissions are quoted as 1.7 te for each EDG and 0.6 te for each SBO, an annual total of 8 te (as NO_2). These emissions are not significant on a National basis, the National atmospheric emissions inventory 2006 gives SO_2 as 676,000 te and NO_2 as 1,595,000 te.

m) For local impact, SO_2 and NO_2 are subject to the Air Quality (AQ) Regulations and the Operator will need to demonstrate that emissions from the diesel installation will not compromise environmental quality standards. EDF and AREVA used our H1 methodology to generate some impact values, PCERsc12.1s2.1.1.3:

   i) The long-term impacts (assessed as an annual average) of both SO_2 and NO_2 are at low levels compared to the AQ standards and we do not consider this to be a matter.

   ii) The short-term impacts are more difficult to assess. The AQ standards relate to exceedences in a year, and H1 is only appropriate to give a rough indication of matters. Further, H1 is very pessimistic for emissions from a combustion plant. The PCER shows NO_2 as particularly significant.

130 We used our internal screening model (based on the ADMS model) to give a more accurate assessment of AQ impacts. We used inputs of 1.91 g s^{-1} for SO_2 and 33.81 g s^{-1} for NO_2 (the emission rates for one EDG) and assumed 88 hours of operation in a year for the annual average. The maximum concentrations were found at a distance of about 400 m:

a) annual average SO_2 = 0.01 µg m^{-3} – not significant against our environmental assessment level of 50 µg m^{-3};

b) annual average NO_2 = 0.16 µg m^{-3} – not significant against the environmental quality standard of 40 µg m^{-3};

c) 99.9th percentile 15 minute mean SO_2 = 15.9 µg m^{-3} – not significant against the environmental quality standard of 266 µg m^{-3} not to be exceeded more than 35 times a year;

d) 99.97th percentile 1 hour mean NO_2 = 101.4 µg m^{-3} – significant against the environmental quality standard of 200 µg m^{-3} not to be exceeded more than 18 times a year but possibly tolerable depending on background levels of NO_2 at a specific site and allowing for infrequent operation.

131 The operator will need to provide site-specific modelling to demonstrate compliance with AQ standards at sensitive locations as part of the permit application. The modelling will need to include any effects on dispersion from the large nuclear power plant buildings near by.

132 EDF and AREVA show an understanding of the requirements of the Environmental Permitting Regulations. There are matters for an operator to resolve at the site-specific stage, such as BAT for the diesel engines and a demonstration that the short-term impact of the emissions of NO_2 does not compromise AQ standards. Nevertheless, in principle and without prejudice to our formal determination of an application in due course, we believe we can issue a permit for the operation of the stand-by diesel generators.

133 The operator will need to identify any Natura 2000 sites near a specific site. We will then determine whether the Habitats Regulations are relevant to the specific site and need to be considered in our determination of a permit. We have not assessed this matter at GDA.

5.4 Conclusion

134 We conclude that:

a) the UK EPR's emergency diesel generators (EDG) will be a Part A(1) installation as described in section 1.1 of chapter 1 in Part 2 of Schedule 1 of EPR 10. The operation of the EDG will require an environmental permit from the Environment Agency;

b) we should be able to issue a permit under EPR 10 for the operation of the EDG, but any application for a permit will need:

   i) a BAT assessment for the chosen diesel engine;

   ii) site-specific modelling to demonstrate compliance with Air Quality Objectives.

6 Environmental Permitting Regulations 2010 (EPR 10): Waste management

135 Non-radioactive waste management is subject to the requirements of the Environmental Permitting Regulations (England and Wales) 2010 (EPR 10) and / or certain sections of the Environmental Protection Act 1990 (EPA 90) and, where relevant, the Hazardous Waste Regulations 2005. See our website for more information on waste matters and the Duty of Care: Environment Agency - Waste

136 Also regulations came into force in April 2008 which means that any construction project in England costing over £300,000 needs a Site Waste Management Plan: Environment Agency - Site waste management plans

6.1 Assessment Objectives

137 All non-radioactive waste management is subject to the requirements of the Environmental Permitting Regulations and / or certain sections of the Environmental Protection Act 1990 and, where relevant, the Hazardous Waste Regulations 2005. Our assessment was aimed at deciding if EDF and AREVA's strategy and proposals for non-radioactive waste management are consistent with:

a) the waste hierarchy (EC, 2008);

b) the objective that waste management is carried out without endangering human health and without harming the environment (EC, 2008);

c) the requirement that waste shall not be treated, kept or disposed of in a manner likely to cause environmental pollution or harm to human health (EPA 90);

d) the duty of care in section 34 (EPA 90)

6.2 EDF and AREVA documentation

138 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER - Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03
UKEPR-0003-040	PCER – Chapter 4 – Aspects having a bearing on the environment during construction phase	00
UKEPR-0010-001	GDA UK EPR – Integrated Waste Strategy Document	02

139 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

6.3 Assessment

140 EDF and AREVA's integrated waste strategy (IWS) outlines their current strategy for managing radioactive and non-radioactive waste produced from the construction, operation and decommissioning of the UK EPR.

141 EDF and AREVA state in their IWS that the production of waste on a UK EPR will be an inevitable consequence of the construction of a power station and operation and management of the site. However, the design will help reduce arisings at the point of origin, including the careful choice of raw materials. This is discussed for the operational phase of a UK EPR in PCERsc3.3 and for the construction phase in PCERsc4.3.

142 EDF and AREVA state in their IWS that during construction a wide range of solid waste will be produced as well as excavation spoil. This includes:

a) packaging;

b) chemicals (material coating, surface treatment) and chemical containers;

c) off spec raw material (wood, plastics, metals).

143 They also state that excavation of the site, including rock crushing and concrete manufacturing, will produce dust and other particulates, and that demolition of existing buildings (if any) will also produce dust.

144 EDF and AREVA state in their IWS that non-radioactive solid waste is produced during the operation and maintenance of the process plant (for example, the maintenance of pipes and equipment), and also as a result of a number of routine activities (for example, removing algae from the water abstraction structure, maintaining control rooms equipment, activities in the workshops, waste from office work, packaging and from the canteen). The range of waste is very large.

145 Non-radioactive waste consists of 'industrial waste' (chemical and material additives, effluents, materials), 'inert waste' (rubble) and 'commercial waste' (canteen, office waste). Several of these types of waste will be classed as hazardous under the Hazardous Waste (England and Wales) Regulations 2005 (as amended) and require special storage and treatment arrangements in accordance with the relevant legislation in order to minimise their impact. Hazardous waste includes solids (batteries, aerosol spray cans, electrical equipment), liquids (solvents, oils) and sludge (paint residues, decontamination products). A more detailed identification of the waste with reference to the European Waste Catalogue and the types of waste found on other nuclear power stations is given in PCERsc3.3.

146 EDF and AREVA claim in their IWS that the non-radioactive solid waste management strategy is designed to comply with the requirements of the Waste Framework Directive as implemented in the UK by the Environmental Permitting Regulations and the Environmental Protection (Duty of Care) Regulations 1991. They state that they will ensure compliance with these regulations by minimising waste production and storing and transferring waste responsibly. They claim that comprehensive waste management procedures will be implemented for all waste streams through the site environmental management system (EMS). We note that the revised Waste Framework Directive has been transposed through the Waste Regulations 2011. These Regulations amend the Environmental Permitting Regulations 2011, and they also contain stand-alone provisions on, for example, the waste hierarchy. We expect future operators to comply with the requirements of current Regulations.

147 EDF and AREVA state in their IWS that the way that daily operation and maintenance activities are organised on the power station is important in minimising the amount of non-radioactive waste produced. They claim that waste production will be minimised through effectively implementing the waste hierarchy. Where

possible, they will re-use potential waste on site. Where it is technically and economically feasible, potential waste will be recycled. Waste may be sent for energy recovery; it will only be disposed of to landfill or to incinerator as a final option, where no other reasonably practicable option exists. Information on the volumes of waste that are disposed, recycled or recovered at other stations is provided in PCERsc3.3. Waste that is recycled or recovered includes batteries, packaging and mixed metals. EDF and AREVA claim that waste produced from the UK EPR will be recycled where appropriate routes are available in the UK. They note that arisings of non-radioactive waste are largely determined by operational procedures and practices, and are not solely dependent on the design.

148 The following table (Table 5 in the IWS) gives an estimate of the annual arisings of the main different types of non-radioactive solid waste.

Waste type	Annual quantity (tonnes)
Inert waste and commercial waste	470
Hazardous (non-radioactive) waste	100
Total arisings (annual)	570

149 Maldon Town Council (GDA51) provided the following response on construction waste: '*We agree with conclusion and note that waste strategy during construction is not mentioned although UK EPR do acknowledge some types of waste they think will be found during construction*'. The Springfields Site Stakeholder Group (GDA96) provided a similar response: '*We agree that any waste generated during construction should be included within the waste hierarchy strategy and covered within site-specific cases*'. EDF and AREVA present data in the PCER (for example volumes of soil and rock to be excavated) which is related to the EPR Flamanville 3 construction, although they acknowledge that the actual figures will be highly site-specific. We have considered these responses on construction waste but we have not identified an assessment finding on this matter as under the provisions of the Site Waste Management Plans Regulation 2008 (SWMPR 08), future operators shall produce a site waste management plan for construction projects with an estimated cost greater than £300,000.

6.4 Conclusion

150 We conclude that EDF and AREVA's strategy and proposals for the management of non-radioactive waste are consistent with:

a) the waste hierarchy;

b) the Waste Framework Directive objective that waste management is carried out without endangering human health and without harming the environment;

c) the requirement of The Environmental Protection Act 1990 (EPA 90) that waste shall not be treated, kept or disposed of in a manner likely to cause environmental pollution or harm to human health;

d) the duty of care under EPA 90.

151 Future operators will need to produce a site waste management plan for each of their construction projects with an estimated cost greater than £300,000 under SWMPR 08.

7 Control of Major Accident Hazards Regulations 1999 (COMAH)

152 These Regulations aim to prevent and limit the consequences of Major Accidents, at over 1,000 installations which use or store significant quantities of dangerous substances, such as oil products, natural gas, chemicals or explosives. A 'Major Accident' could involve an uncontrolled release, fire or explosion, which results in serious danger to human health or the environment. A Major Accident to the Environment (MATTE) would cause severe and / or long-term damage. In England and Wales, responsibility for enforcing COMAH is shared between ourselves and the Health and Safety Executive, working together as a Competent Authority. You can find out more about COMAH and download guidance documents from the website: HSE: Control of major accident hazards (COMAH)

7.1 Assessment Objectives

153 Our assessment was aimed at:

a) Deciding whether a UK EPR would be a COMAH installation.

b) Deciding whether a Major Accident to the Environment (MATTE) would be possible if a UK EPR was a COMAH installation.

7.2 EDF and AREVA documentation

154 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER - Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03

155 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1.

7.3 Assessment

156 EDF and AREVA estimated the quantities of chemicals potentially to be stored on the site of a UK EPR and compared to the qualifying quantities of named dangerous substances to which COMAH applies (COMAH (Amendment) Regulations 2005). The most significant chemicals are shown below (PCERsc3.3s7.3):

Chemical	Stored quantity (te)	Lower tier threshold (te)	Upper tier threshold (te)
Hydrazine hydrate	1.5	0.5	2
Hydrogen	0.38	5	50
Petroleum spirits (diesel for back-up generators)	770	2,500	25,000

157 EDF and AREVA, therefore, state that the site of a UK EPR will become a COMAH lower tier installation because of the expected storage quantity of more than 0.5 tonne of hydrazine hydrate. It should not be an upper tier installation as the inventory is less than 2 tonne.

158 One individual respondent (GDA38) queried the use of hydrazine when other safer oxygen scavengers are available. We only carried out a basic assessment on information presented in GDA to see if COMAH might be applicable. We expect an operator to present more detailed information, including justification for use of hazardous materials, with their site-specific notification.

159 The Health Protection Agency (GDA88) queried whether all chemicals stored, which fall under the COMAH Regulations had been considered. EDF and AREVA did provide a list of all hazardous chemicals stored in the PCER sub-chapter 3.3 Table 8. Only hydrazine storage quantities exceeded a COMAH threshold but the risks associated with the others listed will need to be examined with the site-specific notification. The HPA also agreed that a detailed risk assessment will need to be available before operations commence.

160 The Operator of a lower tier installation needs to notify the Competent Authority (CA) (ourselves and HSE) and prepare a Major Accident Prevention Policy (MAPP) before starting operations. The Operator also needs to be able to demonstrate to the CA that he has taken all measures necessary to prevent Major Accidents and limit their consequences to people and the environment. The notification, MAPP and demonstration will be site-specific matters for the Operator and we have not considered at GDA – our main purpose at GDA was to find out if COMAH would apply.

161 EDF and AREVA also considered the storage quantities of generic categories such as toxic and flammable substances. These are presented in the PCERsc3.3 Table 8. Aggregation of these categories does not exceed any COMAH threshold, so does not affect the lower tier status determined above.

162 Hydrazine hydrate is used in small quantities as an additive to water in the secondary circuit to consume residual oxygen. It is usually delivered to site as a solution in drums or intermediate bulk containers (IBCs) and transferred, as required, to buffer storage tanks in the injection system. Hydrazine is a named carcinogen in the COMAH Regulations – hence the low threshold values – and its main risk is to the workforce.

163 Hydrazine hydrate is a liquid and could have a pathway to the sea in an accident through the site drains. It is classified as dangerous to the environment and is toxic

to aquatic organisms. However, its toxicity diminishes with concentration, it is not very bio-cumulable and tends to decompose in the aquatic environment.

164 EDF and AREVA claim that the UK EPR will contain preventative measures to avoid accidental pollution of the aquatic environment:

a) all containers or tanks will be bunded;

b) any failure of a bund or spillage outside a bund would be collected by the CILWDS drain system and held in a discharge storage tank (an ExLWDS tank) pending a decision on disposal;

c) hydrazine systems have automatic shut-offs in event of failure.

165 EDF and AREVA claim that the risk of any hydrazine reaching the sea is very low due to the preventative measures. Also, the low quantity of hydrazine stored and its immediate dilution by the cooling water flow mean that consequences would be very limited. They conclude that a Major Accident to the Environment (MATTE) is highly unlikely from any accident involving hydrazine. We agree with this qualitative risk assessment at this time for GDA, but we will need to assess this in more detail at the site-specific stage.

7.4 Conclusion

166 We conclude that:

a) the UK EPR will store hydrazine (a dangerous substance as defined in the COMAH regulations) in quantities exceeding the lower tier COMAH threshold and will, therefore, be a COMAH lower tier installation;

b) the EDF and AREVA qualitative assessment that a Major Accident to the Environment (MATTE) involving hydrazine is highly unlikely is reasonable. The Operator will need to provide a more detailed risk assessment before any hydrazine is first stored;

c) the Operator should be able to demonstrate that all measures necessary to prevent Major Accidents and limit their consequences to people and the environment have been taken for a UK EPR installation.

167 The above conclusion relates only to the consequences of Major Accidents to the Environment (MATTE) from hydrazine storage. Our partner in the Competent Authority for COMAH regulation, HSE, is responsible for assessing matters relating to impacts on people.

8 EU Emissions Trading Scheme (EU ETS)

168 The scheme is one of the policies introduced across the European Union (EU) to help it meet its greenhouse gas emissions reduction target under the Kyoto Protocol (UN, 1998). The EU has to make an 8 per cent reduction on 1990 levels by the first Kyoto Protocol commitment period (2008 - 2012). The UK Kyoto target is 12.5 per cent. The EU ETS will also contribute to delivering the UK's domestic goal of a 20 per cent reduction in carbon dioxide emissions by 2010.

169 The EU ETS Directive requires all installations carrying out activities listed in its Annex I to hold a greenhouse gas emissions permit. The conditions of the permit will require installations to monitor and report emissions in accordance with the Commission's guidelines for monitoring and reporting. Each year emissions data must be verified, and the equivalent number of allowances surrendered. All transactions and surrendering of allowances take place on a national registry.

170 The Environment Agency runs the scheme for England and Wales. You can find out more on our website: Environment Agency - EU Emissions Trading Scheme

8.1 Assessment Objectives

171 Our assessment was just aimed at identifying whether the UK EPR would be an installation under the EU ETS, that is a combustion installation with a rated thermal input exceeding 20 MW.

8.2 EDF and AREVA documentation

172 The Pre-Construction Environmental Report (PCER) is divided into chapters and sub-chapters (provided as separate documents) and has supporting documents. We referred to the following documents to produce this report:

Document reference	Title	Version number
UKEPR-0003-011	PCER-Sub-chapter 1.1 - Introduction	04
UKEPR-0003-012	PCER – Sub-chapter 1.2 – General description of the unit	02
UKEPR-0003-030	PCER – Chapter 3 – Aspects having a bearing on the environment during operation phase	03

173 We use short references in this report, for example: PCER sub-chapter 6.2 section 1.2.1 = PCERsc6.2s1.2.1;

8.3 Assessment

174 PCERsc3.4s4.2.1.1 states there will be:

a) 4 main emergency backup electricity diesel generators each rated at around 17.6 MW thermal input; and

b) 2 ultimate emergency backup diesel generators (Station Black Out) each rated at around 6 MW thermal input.

175 The total thermal input of the 6 diesel generators will be 82.4 MW thermal.

8.4 Conclusion

176 A UK EPR will be an installation required to hold a greenhouse gas emissions permit. An Operator of a specific site will need to obtain such a permit from us before any combustion plant operates.

9 Public comments

177 No relevant public comments were received on the subject of other environmental regulations during our detailed assessment stage.

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While every effort has been made to ensure the accuracy of the references listed in this report, their future availability cannot be guaranteed.

Abbreviations

AQ	Air Quality
BAT	Best available techniques
BOD	Biological oxygen demand
C&I	Control and Instrumentation
CILWDS	Conventional island liquid waste discharge system
COD	Chemical oxygen demand
COMAH 99	Control of Major Accident Hazards Regulations 1999 (amended 2005)
CSTS	Coolant Storage and Treatment System
CVCS	Chemical and Volume Control System
EA 95	Environment Act 1995
EAL	Environmental Assessment Level
EDG	Emergency diesel generator
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPA 90	Environmental Protection Act 1990
EPR 10	Environmental Permitting (England and Wales) Regulations 2010
EPRB	GDA UK EPR – BAT demonstration, document UKEPR-0011-001
EPRB 3.5s1.2	EPRB form 3.3 section 1.2 (example reference)
EQS	Environmental Quality Standard
ETB	Effluent Treatment Building (this is also referred to as the 'Waste Treatment Building')
ExLWDS	Additional liquid waste discharge system
GDA	Generic design assessment
GWPS	Gaseous Waste Processing System
HSE	Health and Safety Executive
HVAC	Heating, ventilation and air conditioning system
IWS	GDA UK EPR – Integrated Waste Strategy Document UKEPR-0010-001 Issue 00
JPO	Joint Programme Office
LRMDS	Liquid radwaste monitoring and discharge system
LWPS	Liquid Waste Processing System
MAPP	Major Accident Prevention Policy
MATTE	Major accident to the environment
MCERTS	Monitoring Certification Scheme
NVDS	Nuclear Vent and Drain System
P&ID	Process and information document
ONR	Office for Nuclear Regulation (an Agency of the Health & Safety Executive, formerly HSE's Nuclear Directorate)

PCER	Pre-Construction Environmental Report
PCERsc3.3s4.1	PCER sub-chapter 3.3 section 4.1 (example reference)
PCSR	Pre-Construction Safety Report
PPC	Pollution Prevention and Control
PWR	Pressurised water reactor
RCS	Reactor Coolant System
REPs	Radioactive substances environmental principles
RI	Regulatory Issue
RO	Regulatory Observation
SBO	Station Black Out
SG	Steam Generator
TQ	Technical Query
TRO	Total Residual Oxidant
WRA 91	Water Resources Act 1991

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